POPULAR SCIENCE

JANUARY · 35c Monthly

Firsthand performance report on

OUR DEADLIEST BOMBER

Who Are America's Worst Car Drivers?

SKIPPED ME AGAIN!

POOR BURT! HE MISSED OUT ON THAT PROMOTION AGAIN!

I WAS DETERMINED TO MAKE GOOD IN MY JOB...BUT DETERMINATION, I FOUND, WAS NOT ENOUGH!

I HAD PLENTY OF EXPERIENCE. AND THE BOSS SEEMED TO LIKE ME. I LACKED JUST ONE THING— **TRAINING!**

SORRY, BURT! I KNOW YOU'VE WORKED HERE LONGER. BUT TED HAS THE SPECIAL TRAINING WE NEED. YOUR CHANCE WILL COME ...SOMEDAY!

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SIX MONTHS LATER.. I.C.S. SENT MY BOSS REGULAR REPORTS OF MY PROGRESS. THEN ONE MORNING...

BURT, I'VE JUST MADE YOU THE ASSISTANT MANAGER OF YOUR DIVISION...AT **$15 MORE A WEEK.** AND THE WAY YOU'RE GOING NOW, THIS IS JUST THE BEGINNING.

GOSH! THANKS MR. TAYLOR!

I GOT IT, HONEY! I GOT THE PROMOTION! OUR MONEY WORRIES ARE OVER! TODAY'S OUR **LUCKY DAY!**

TODAY **AND** THE DAY YOU MAILED THAT I.C.S. COUPON!

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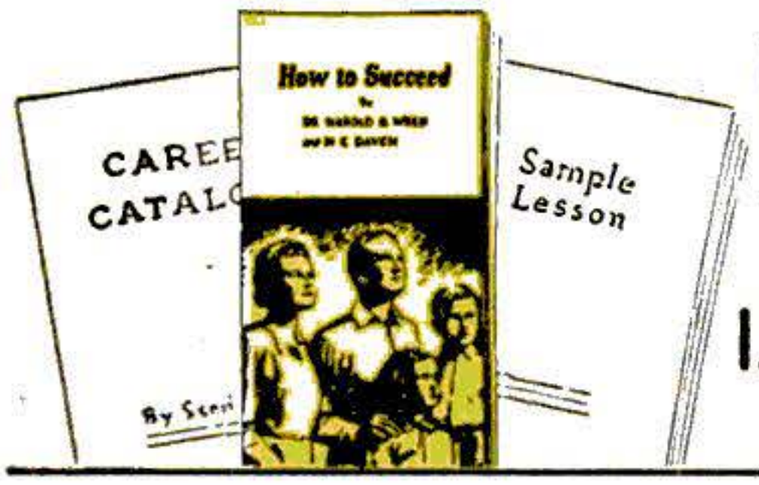

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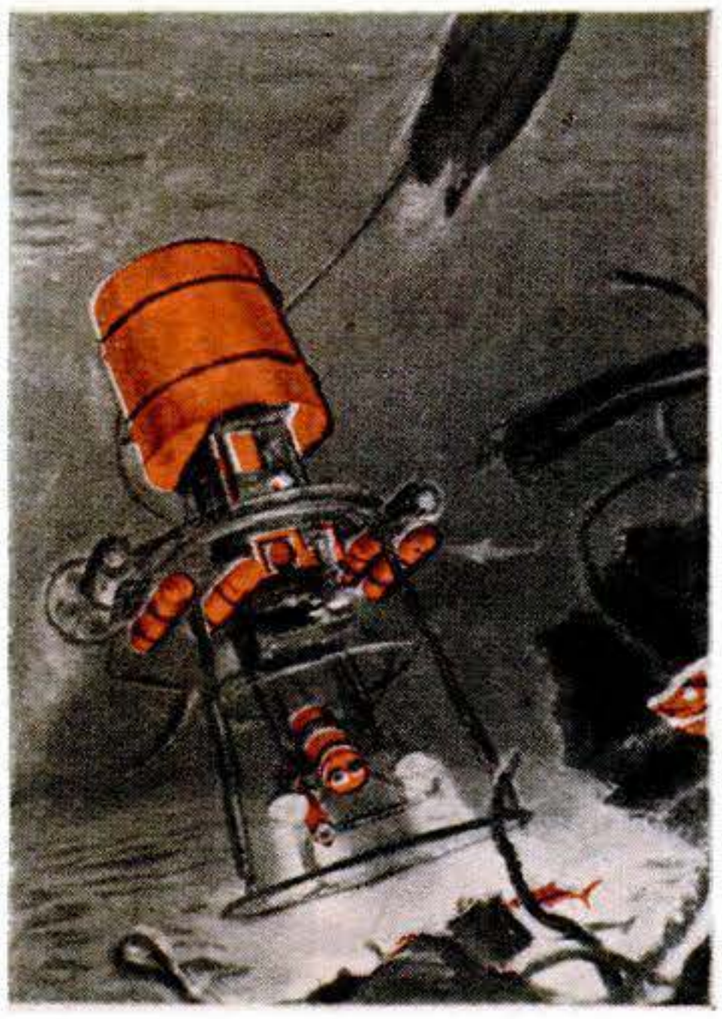
Popular Science Monthly

January, 1957

Eight tiny motors inside push and pull. Result: This Ford hardtop convertible converts!



Here's Operation Fisheye: a remote-controlled TV camera for deep-water look-sees

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Science reveals some secrets of this "death of each day's life"

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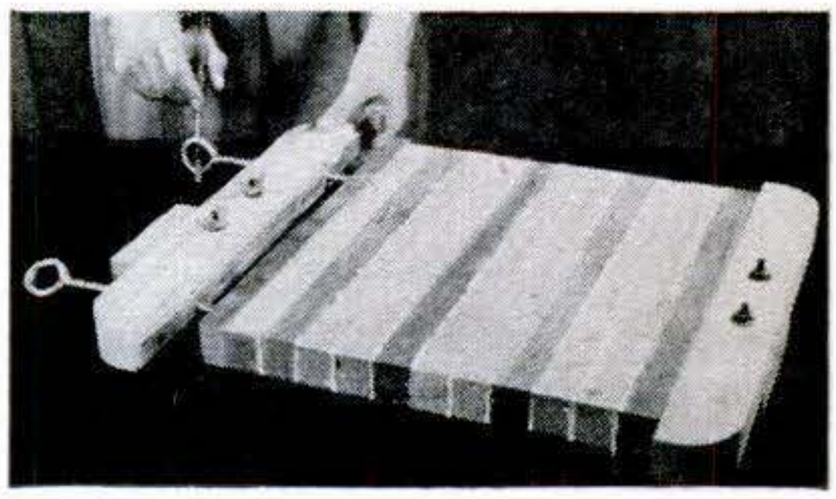

How-to-do-it ideas from an expert help you get a new hold on work

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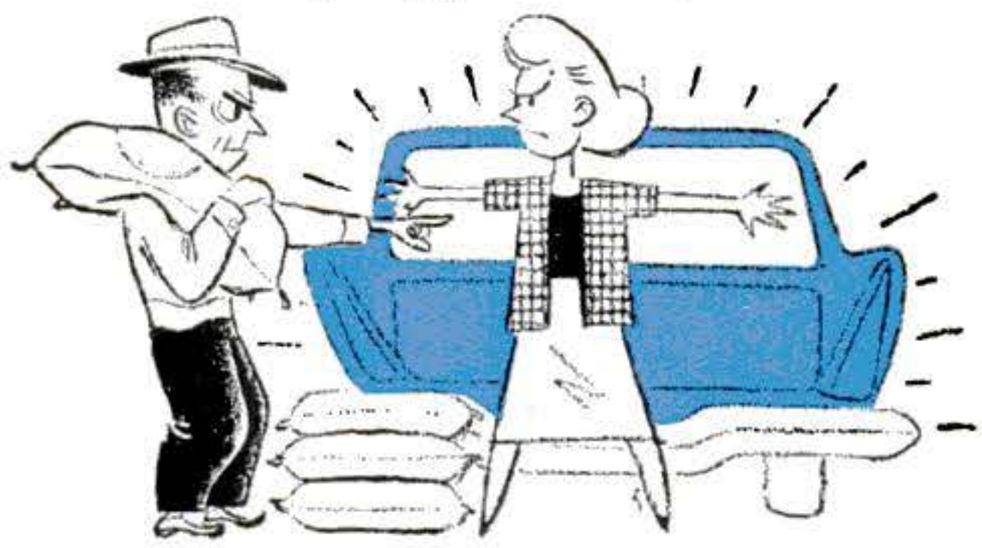
PS Readers

TALK BACK

Those Good *Old* Station Wagons (Sob!)

YOUR October articles on the '57 Ford and the 14-inch tires serve to emphasize the point made by Dr. Robert L. Rice's letter in the same issue. [Dr. Rice decried the trend to station wagons that are strong on style but weak on utility.]

The all-metal station wagon never really had a chance. From the very start, stylists were designing the utility *out* of these



vehicles. My '53 model is a real honey compared to the current crop, but it can't be driven in the rain unless tightly closed up, it's difficult to clean, there's no way of lashing loads inside or out, it has to be unloaded if the spare tire is needed, and it bottoms on country roads that no one would have considered bad 10 years ago.

My next car will be an all-metal station wagon, but unless the boys in Detroit get some realistic ideas, it will have to be handmade.

JOHN C. KLIER, Baltimore

The boys in Detroit did get some ideas —for utility and style. You'll see them all in a special report on the '57 station wagons next month, part of POPULAR SCIENCE'S *big auto issue.*

More on Hi-Fi

WE WOULD like to extend our sincere congratulations on your excellent and authoritative report, "How to Choose the Right Turntable" [Oct]. We also extend our thanks for your accurate presentation of our product, the Metzner "Starlight" turntable.

Your tabular listing gave the dimensions of our main bearings as "not available." Just to set the record straight, our turntable-shaft top main bearing has ½-inch outside diameter, ⅜-inch inside diameter and 23/64-inch length. The lower main bearing is ⅜ outside diameter, 15/64 inside diameter, 15/64 length. Both of these bearings are made of free-machining brass and are provided with felt oil wicks.

WILL A. CONNELLY, Metzner Engineering Corp., Hollywood, Calif.

WE FOUND your article on hi-fi pickup cartridges [Nov.] very well done and appreciate the kind words you had to say about our Ronette Cartridge.

However, we should like to take issue with you on one sentence on page 240, where you state: "Unfortunately it [the Ronette] lacks a diamond microgroove stylus." We do have, and have had for a considerable length of time, diamond styli available for all our cartridges.

IRA MOLAY, Ronette Acoustical Corp., New York City

Brains, Not Degrees, Count

IN "Late News" [Oct.] you state: "Experts think that perhaps as much as five percent can be added to our reservoir of engineers by upgrading skilled workers." I should like to make a correction to that statement.

According to our research over a period of several years, the supply of engineers can be increased more than 10 percent by upgrading some of the graduates of two-year technical schools, the better correspondence courses, and the otherwise self-educated, on-the-job trained men.

Many employers will do well to reappraise their philosophy, and think of recruiting employees in terms of brain power rather than in terms of ivy-covered bricks.

JOSEPH JAYKO, Director, Cramwell Research Institute, Adams, Mass.

How Fast Can a VW Go?

ONE of the Volkswagen owners in the group where I work says that he has

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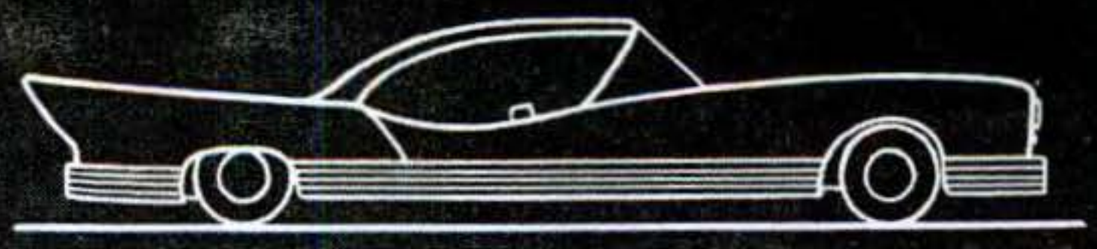


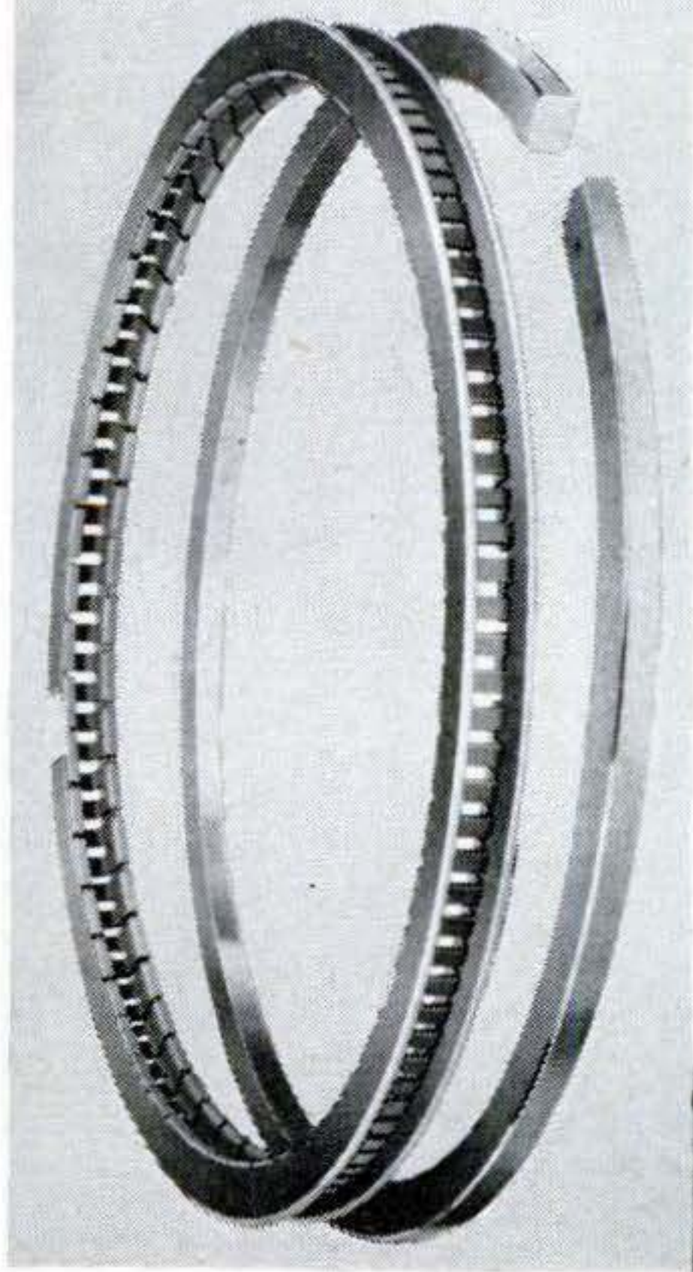
You may have to wait for this, but...

Designed by Raymond L. Jordan

right now you can enjoy that "New Car Feel"

While you're waiting for your "dream car" there's no need to put up with sluggish performance in the car you're now driving. Your Doctor of Motors—your skilled mechanic—knows how to restore the responsive power of your car's engine and to bring back that satisfying "New Car Feel."

Your Doctor of Motors also knows that there is no better way to restore full-power performance with positive oil control than to install Perfect Circle 2-in-1 Chrome piston rings. Perfect Circles are plated with thick, solid chrome that resists wear, more than doubles the life of cylinders, pistons and rings. See your Doctor of Motors for an engine check-up today! Perfect Circle Corporation, Hagerstown, Ind., The Perfect Circle Co., Don Mills, Ontario.



Install

PERFECT CIRCLE

2-in-1

Chrome Piston Rings

You'll be surprised how quickly and economically your Doctor of Motors can bring back the "New Car Feel" to your car!

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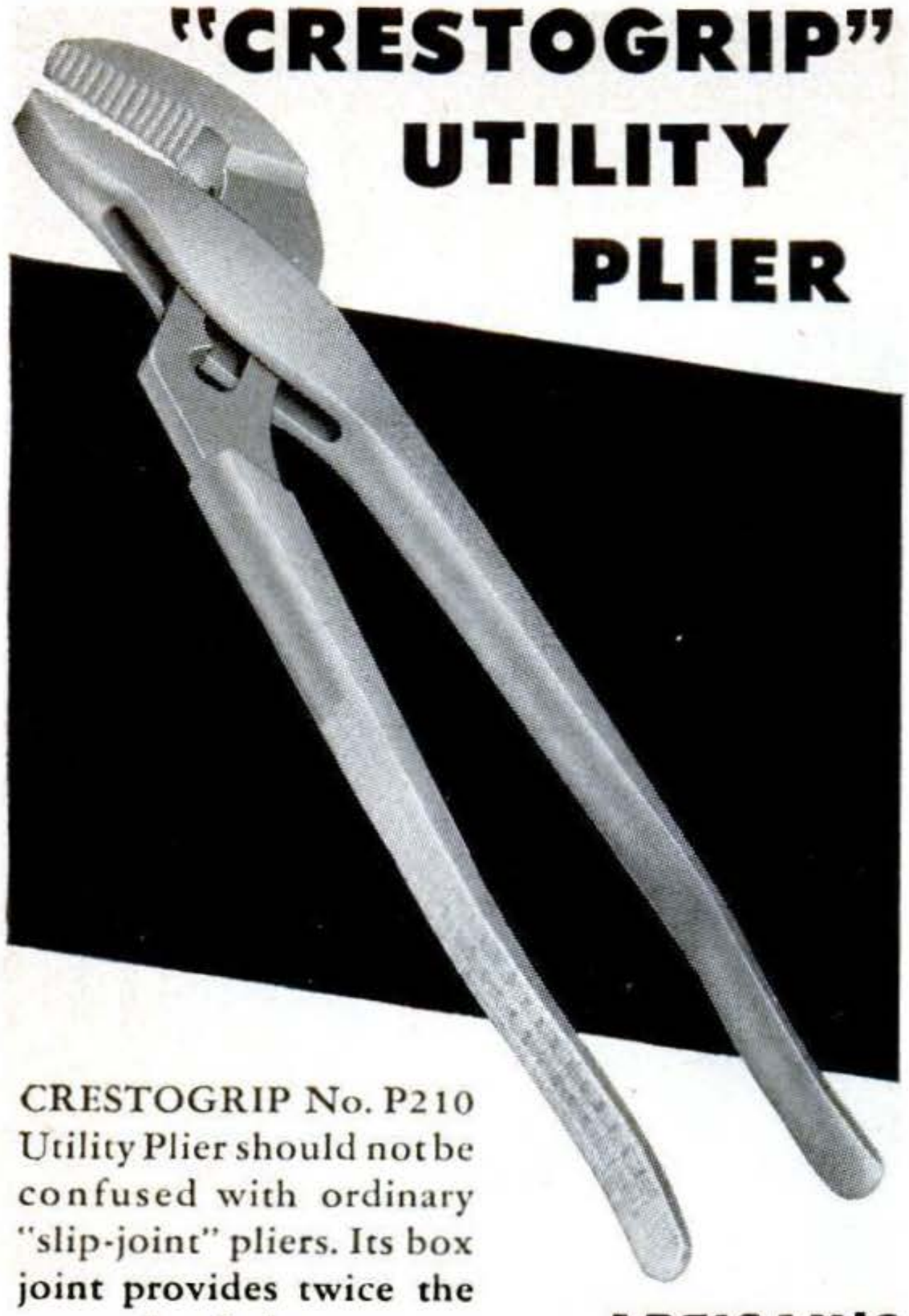
"CRESTOGRIP" UTILITY PLIER



CRESTOGRIP No. P210 Utility Plier should not be confused with ordinary "slip-joint" pliers. Its box joint provides twice the strength of the conventional lap joint and eliminates sideways twist and strain. Grips flat, square, hex or round objects with powerful leverage. Adjusts to four positions up to 1½" capacity. It has no rivet projections and measures only ½" at its thickest point. Finished in rust-resistant zinc plate.

ARTISAN'S TIE CLASP

● For the craftsman or hobbyist who is proud of his skill, a handsome gold-plated clasp designed by a leading jewelry manufacturer. A $2.00 value... yours for 50¢, post paid. Write Crescent Tool Co., Jamestown, N. Y., Dept. S.

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reached a speed of 75 to 80 miles per hour. This seems to be hardly believable, and we would appreciate confirmation one way or the other.

A. Rimol, Republic Aviation Corp.
Farmingdale, N. Y.

Most VWs in good tune make 67 to 68 m.p.h. true on a level, windless road, and indicate about 72 while doing it. A higher true speed usually takes help from wind or gravity.

X Frames Are for Convertibles

You made a nice try in your comparison of the new Chevy, Ford and Plymouth [Nov.]. But you sure got some of the new Chevy owners here in the Ozarks stirred up. After seeing your article, they have been rushing to their dealers fighting mad, demanding an explanation as to why they were cheated out of the center X member.

Your picture showed one in the Chevy's chassis. They finally learned that only the convertibles have the frame reinforced with the special center X member. Ford, Plymouth and other convertibles have similar X members.

Ben J. Wekenborg, Argyle, Mo.

We goofed.

His Chrysler Is Hot

I'm always amused at writers who take pot shots at Chrysler speed exploits [see "Readers Talk Back," Oct.].

My '56 Windsor—sans any optional equipment—was recently clocked at 29.9 seconds for a flying mile (three witnesses, two watches) on a blocked-off speed strip. To save you figure doodlers a little pencil lead, that's in excess of 120 m.p.h.

Any takers from the "stock" GM-Ford set?

Dale R. Nelson, Columbus, Neb.

British Billions Are Bigger

How big *is* a billion [see Oct., p. 112]?

My dictionary says, "a million millions; in U.S.A. and France, one thousand millions." Here in England similar variations occur with other very large numbers. For septillion we have 10^{42} (one followed by 42 noughts); in the U.S.A. or France a sep-

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"We're looking for people who like to draw"

BY ALBERT DORNE
Famous Magazine Illustrator

DO YOU LIKE TO DRAW? If you do—America's 12 Most Famous Artists are looking for you. We want you to test your art talent!

Too many people miss a wonderful career in art—simply because they don't think they have talent. But my colleagues and I have helped thousands of people get started. Like these—

Don Smith lives in New Orleans. Three years ago Don knew nothing about art—even doubted he had talent. Today, he is an illustrator with a leading advertising agency in the South—and has a future as big as he wants to make it.

Harriet Kuzniewski was bored with an "ordinary" job when she sent for our talent test. Once convinced that she had the makings of an artist—she started to study art at home. Soon she was offered a job as a fashion artist. A year later, she became assistant art director of a big buying office.

Pipe-fitter to Artist

John Busketta is another. He was a pipe-fitter's helper with a big gas company—until he decided to do something about his urge to draw. He still works for the same company—but as an artist in the advertising department. At a big increase in pay!

Don Golemba of Detroit stepped up from railroad worker to the styling department of a major automobile company. Now he helps design new car models!

Salesgirl, Clerk, and Father of Three Win New Careers

A West Virginia salesgirl studied with us, got a job as an artist, later became advertising manager of the best store in Charleston.

John Whitaker of Memphis, Tenn., was an airline clerk when he began studying with us. Two years later, he won a national cartooning contest. Recently, a huge syndicate signed him to do a daily comic strip.

Stanley Bowen—a married man with three children, unhappy in a dead-end job—switched to a great new career in art. Now he's one of the happiest men you'll ever meet!

Profitable Hobby—at 72

A great-grandmother in Newark, Ohio, decided to use her spare time to study painting. Recently, she had her first local "one man" show—where she sold thirty-two water colors and five oil paintings.

Cowboy Starts Art Business

Donald Kern—a cowboy from Miles City, Montana—studied art with us. Now he paints portraits and sells them for $250 each. And he gets all the business he can handle.

Gertrude Vander Poel had never drawn a thing until she started studying with us. Now a swank New York gallery exhibits her paintings for sale.

How about you? Wouldn't you like to trade places with these happy artists?

Free Art Talent Test

We want to help you find out if you have the talent for a fascinating money-making art career (part time or full time). We'll be glad to send you our remarkably revealing 12-page talent test. Thousands formerly paid $1 for this test. But we'll send it to you *free*—if you sincerely like to draw. No obligation. But mail coupon today.

ALBERT DORNE

NORMAN ROCKWELL

JON WHITCOMB

AL PARKER

HAROLD VON SCHMIDT

STEVAN DOHANOS

FRED LUDEKENS

PETER HELCK

ROBERT FAWCETT

BEN STAHL

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AUSTIN BRIGGS

FAMOUS ARTISTS SCHOOLS

Studio 73, Westport, Conn.

Send me, without obligation, your Famous Artists Talent Test.

Mr.
Mrs. _____ Age____
Miss (PLEASE PRINT)

Address _____

City, Zone, State _____

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tillion is 10^{24} (one followed by 24 noughts). How big is a billion? Take your choice!

C. NORMAN FLETCHER,
Cheadle Hulme, England

Fun with Big Numbers

I RECALL reading years ago that it is impossible to fold a piece of paper .001 inch thick 50 times because the stack would reach to the moon . . . or something fantastic like that.

Out of curiosity I multiplied .001 by 2, then the answer by 2, and so on and on 50 times. I tried to avoid error but came up with 1,125,899,906,-843 inches, which reduces to 17,769,884 miles or 74 trips to the moon.

Incredible! How high *would* the stack of paper be if you could fold it 50 times?

ANDREW VENA, Philadelphia

We used logarithms, and got practically the same answer Reader Vena did.

PS Boat Is No Weekend Project

MANY years ago PS published plans for an 18-foot cabin cruiser. I built it—or rather started it. Then I went into the Army in 1940. I returned in 1941 and worked at it for a short time and then went back into the Army. On my return in 1945 I started again and finished in 1946.

This is one of the finest all-around home-built jobs I have ever seen.

CLAUDE H. SPICER, Auburn, N. Y.

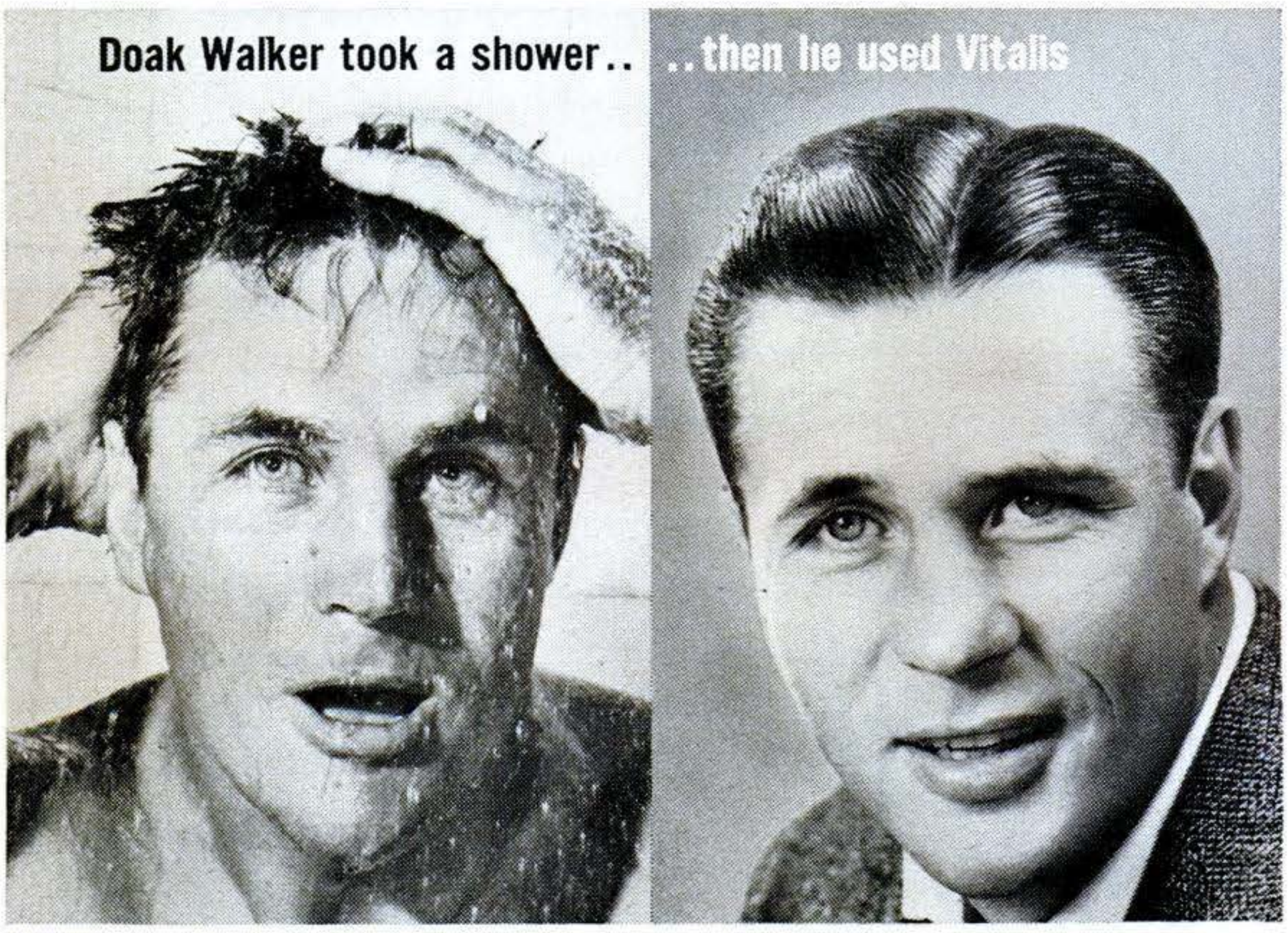
Substitution for the Door Phone

I STARTED out to build your transistor door phone [Sept.] and bought all the parts that you listed. But I was unable to obtain the three-position switch, Mallory 7243C. I was told that this had been discontinued.

A. E. PETERSON, Chicago

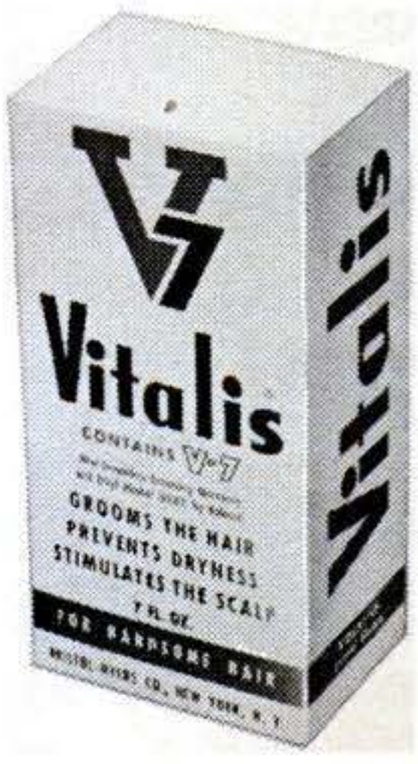
Mallory stopped making the 7243C switch after our article was prepared, a development obviously beyond our control. Another switch, Mallory 6243, will do—it is identical to the 7243C except that it lacks a spring return. The 6243 is, at this writing, in production and should be available from local electronics-parts suppliers.

New greaseless way to keep your hair neat all day



Vitalis scores high with this all-time football great.

TACKLES DRIED-OUT HAIR . . . New Vitalis keeps hair in place and prevents dryness with V-7, the *greaseless* grooming discovery. You never have an over-slick, plastered-down look. Try it. You'll *like* it.



New VITALIS® Hair Tonic with V-7®

ANOTHER FINE PRODUCT OF BRISTOL-MYERS

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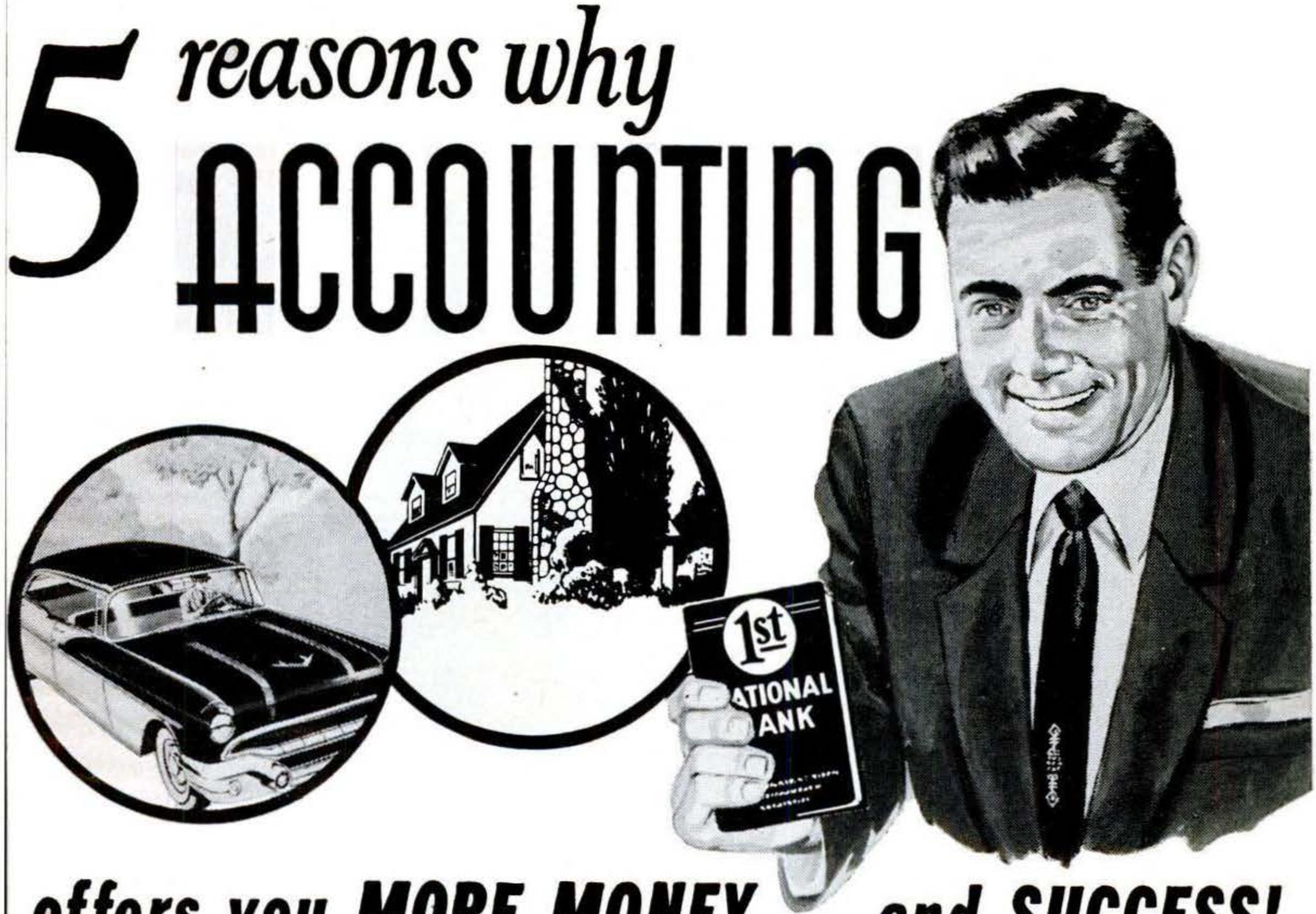
5 *reasons why* ACCOUNTING



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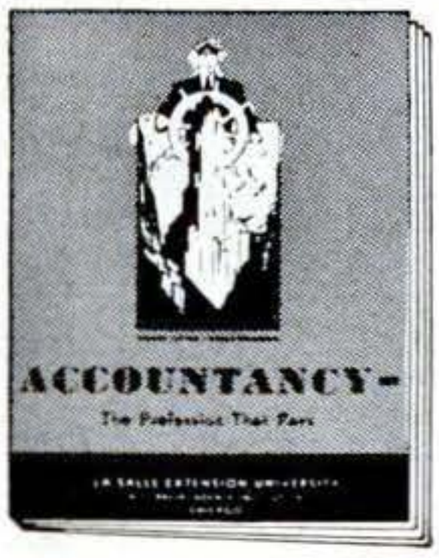

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Please send me, free of all cost or obligation, your latest book, "Accountancy, The Profession That Pays."

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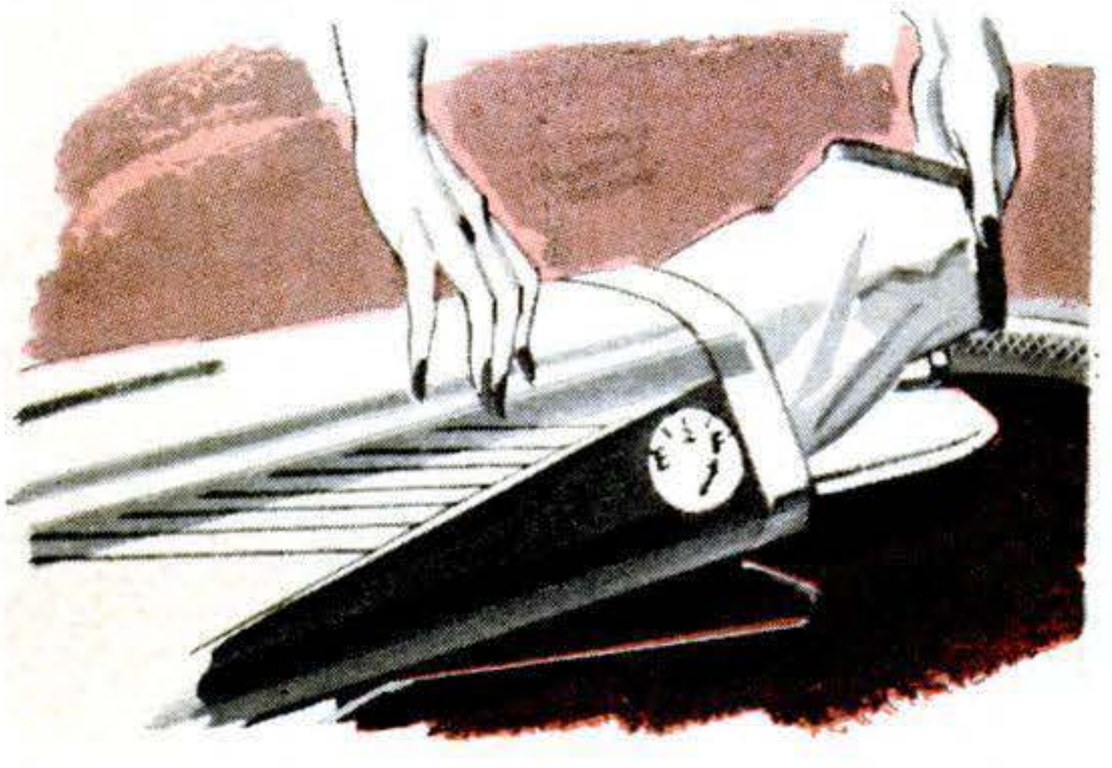
"I'd like to see them make..."

CANDY TONGUE DEPRESSORS to induce obstinate little children to "open wide" for throat examinations. Inspection over, the youngster gets the candy.—*D. Hornbrook, S. Burlington, Vt.*

REAR-END HYDRAULIC SHOCK ABSORBERS on semitrailers. They would automatically apply a backing carrier's brakes on contact with a loading dock.—*B. E. Williams, Fort Wayne, Ind.*

A COMBINATION PENCIL AND LEVEL. A flat-sided mechanical pencil with a built-in level would slide into your pocket and be handy for many carpentry jobs.—*Paul Katsuki, Media, Pa.*

ILLUMINATED KEYHOLES on car doors. Flipping aside the lock cover or pushing the release button would light a bulb inset in one door handle.—*James Neil, Craigsville, W. Va.*



A VACUUM-CLEANER GAUGE actuated by pressure of the dust when the bag needs emptying. It would save paper inserts from bursting.—*Max Wheat, Mountain Home, Ark.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE MONTHLY readers. What is *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I send to build many circuits common to Radio and Television. With my Servicing Course you build the modern Radio shown at left. You build a Multitester and use it to help make $10, $15 a week fixing sets in spare time while training. All equipment is yours to keep. Coupon below will bring book of important facts. It shows other equipment you build.

You Practice BROADCASTING with Kits I Send You

As part of my Communications Course I send you parts to build low-power Broadcasting Transmitter at left. Use it to get practical experience. You put this station "on the air" . . . perform procedures demanded of broadcasting station operators. An FCC Commercial Operator's License can be your ticket to a bright future. My Communications Course trains you to get your license. Mail coupon. Book shows other equipment you build for practical experience.

I Will Train You at Home in Spare Time to be a RADIO-TELEVISION Technician

TELEVISION

Making Jobs, Prosperity

25 million homes have Television sets now. Thousands more sold every week. Trained men needed to make, install, service TV sets. About 200 television stations on the air. Hundreds more being built. Good job opportunities here for qualified technicians, operators, etc.

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N.R.I. Training Leads to Good Jobs Like These

I TRAINED THESE MEN

"I have progressed very rapidly. My present position is Studio Supervisor with KEDD Television, Wichita."—Elmer Frewaldt, 3026 Stadium, Wichita, Kans.

"Fix sets part time in my shop. Made about $500 first three months of the year. Could have more but this is about all I can handle."—Frank Borer, Lorain, Ohio.

"I've come a long way in Radio and Television since graduating. Have my own business on Main Street."—Joe Travers, Asbury Park, New Jersey.

"I didn't know a thing about Radio. Now have a good job as Studio Engineer at KMMJ."—Bill Delzell, Central City, Nebraska.

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. SERVICING: Home and Auto Radios, Television Receivers, FM Radios, P.A. Systems. IN RADIO PLANTS: Design Assistant, Technician, Tester, Serviceman, Service Manager. SHIP AND HARBOR RADIO: Chief Operator, Radio-Telephone Operator. GOVERNMENT RADIO: Operator in Army, Navy, Marine Corps, Forestry Service Dispatcher, Airways Radio Operator. AVIATION RADIO: Transmitter Technician, Receiver Technician, Airport Transmitter Operator. TELEVISION: Pick-up Operator, Television Technician, Remote Control Operator.

Start Soon to Make $10, $15 a Week Extra Fixing Sets

My training is practical, complete; is backed by 40 years of success training men at home. My well-illustrated lessons give you basic principles you need and my skillfully developed kits of parts "bring to life" things you learn from the lessons. I start sending you special booklets the day you enroll, that show you how to fix sets. Multitester you build with my parts helps you discover and correct set troubles, helps you make money fixing neighbors' sets in spare time while training. Many make $10, $15 a week extra this way.

Mail Coupon — Find Out What Radio-Television Offer You

Act now to get more of the good things of life. I send actual lesson to prove NRI home training is practical, thorough. My 64-page book "How to be a Success in Radio-Television" shows what my graduates are doing and earning. It gives important facts about your opportunities in Radio-Television. Take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mail coupon now to: J. E. SMITH, President, Dept. 7AB, National Radio Institute, Washington 9, D. C. Our 40th year.

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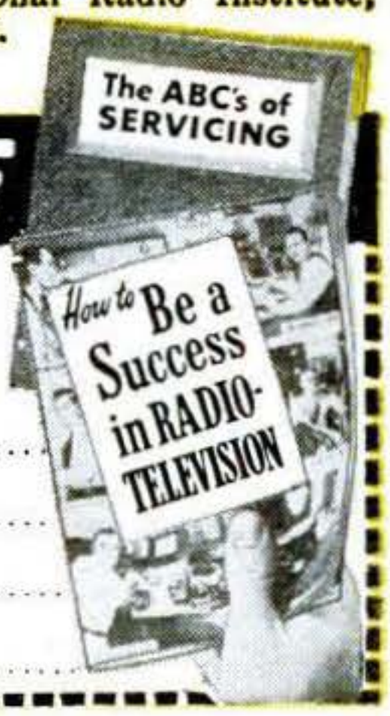

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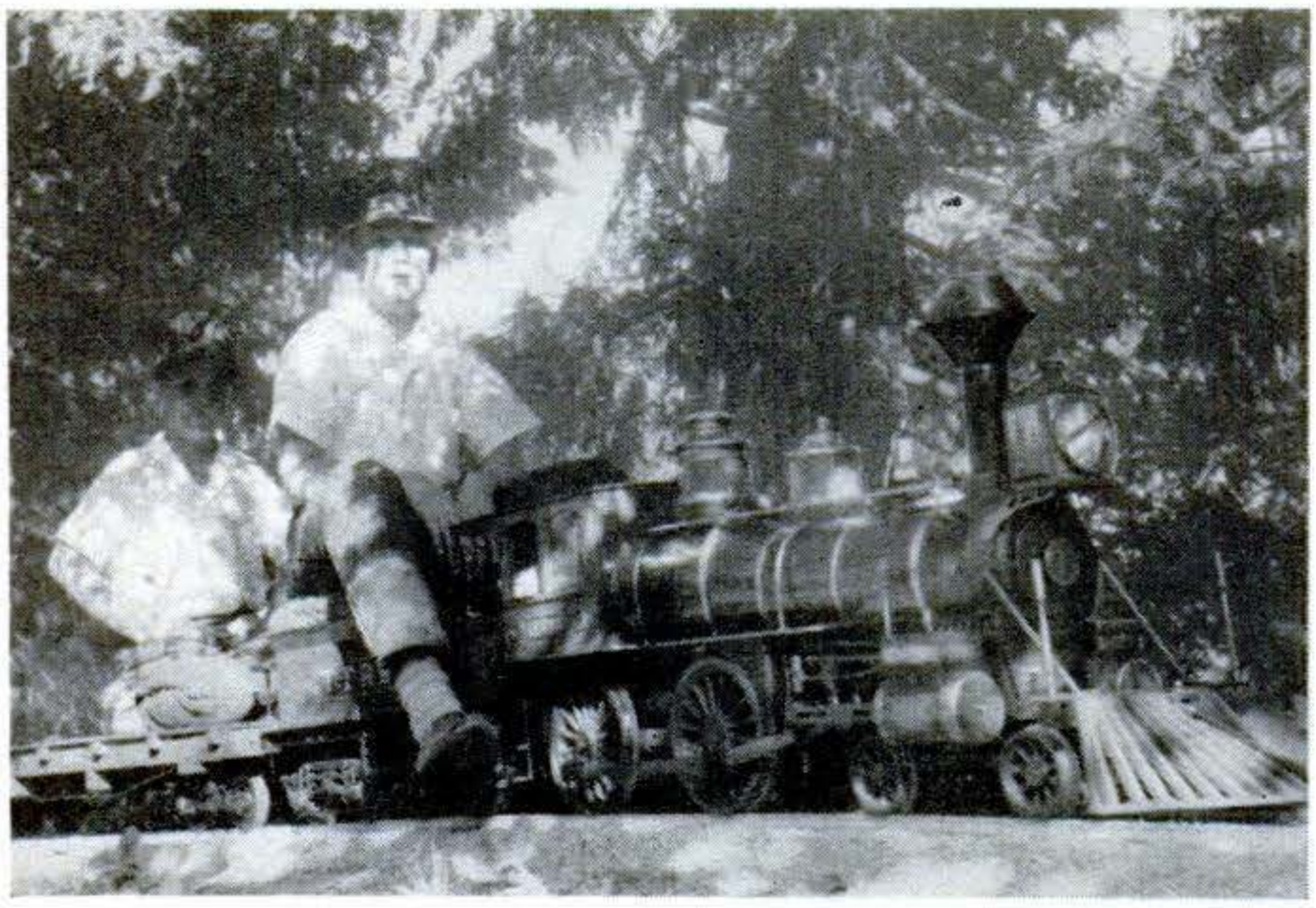
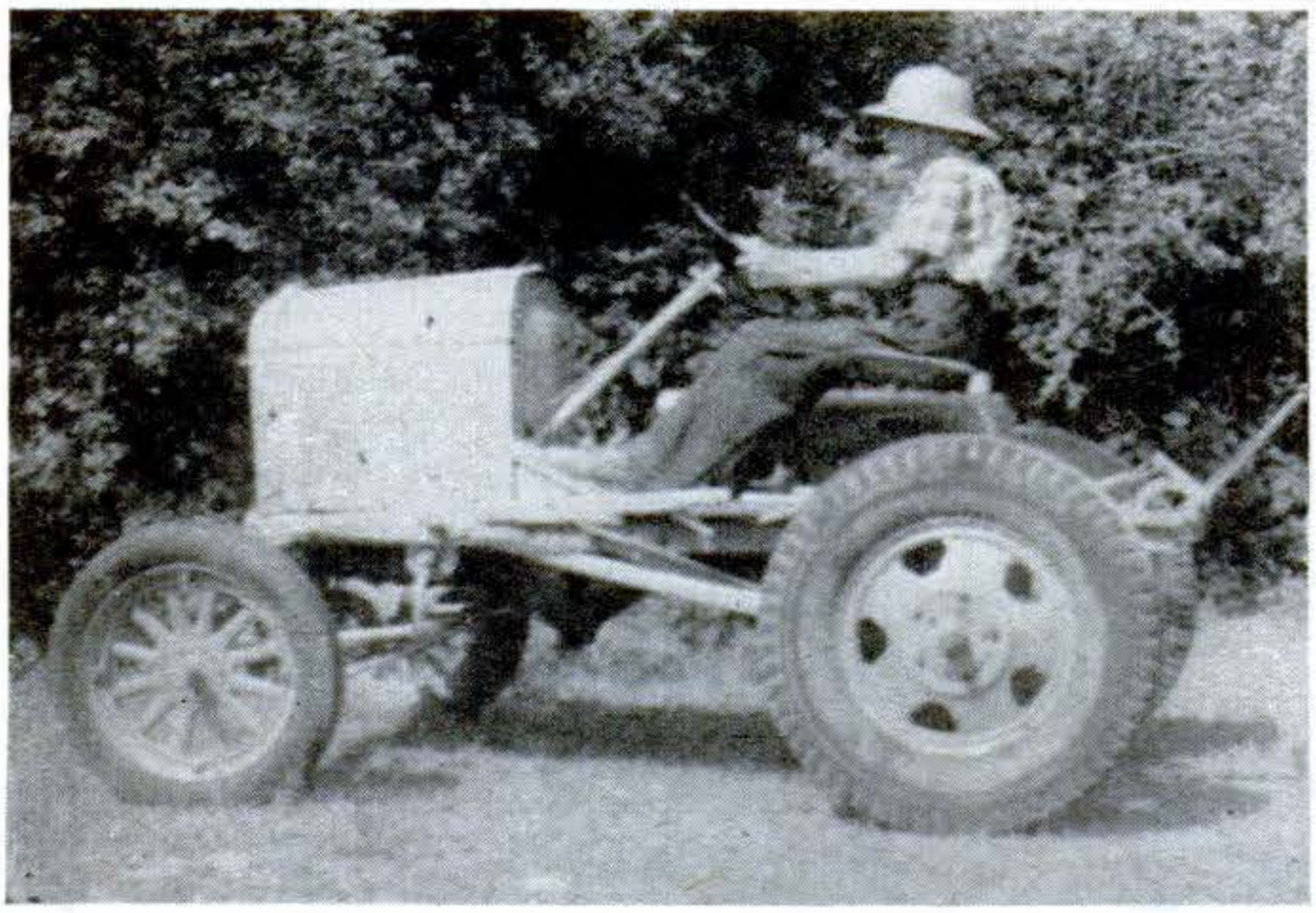
Prize Projects BY PS READERS



Back-Yard Choo Choo. Dwight Durkee Jr. of Cupertino, Calif., says he didn't know a firebox from a snifting valve when he began the drawings and patterns for this 1873 locomotive. Some 1,500 hours later, a 100-pound head of steam had it rolling. He fabricated most parts with a hacksaw and acetylene torch, jobbed out a few big castings to a foundry.

Robot Toys Do Tricks. With dials and push-buttons (far left), modelmaker Byron Sefton of Greenwood, Ind., plays games with his fleet of cars and trucks. He can set up a crash between two whizzing cars, and then send an ambulance to the scene with lights flashing and siren screaming. A tiny stretcher pops out (right) to load the "victim."



Model T Tractor. Turning from tiny gears and wheels to big ones, watchmaker C. G. Peterson of Rosepine, La., built this tractor. He added a Model A radiator, a '32 Chevy steering gear and a Nash transmission to the shortened frame of a Model T with two-speed rear axle. A Model T engine pulls the tractor and a plow, turning a 9″ furrow, at four m.p.h.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to POPULAR SCIENCE MONTHLY's Mechanics and Handicraft Editor, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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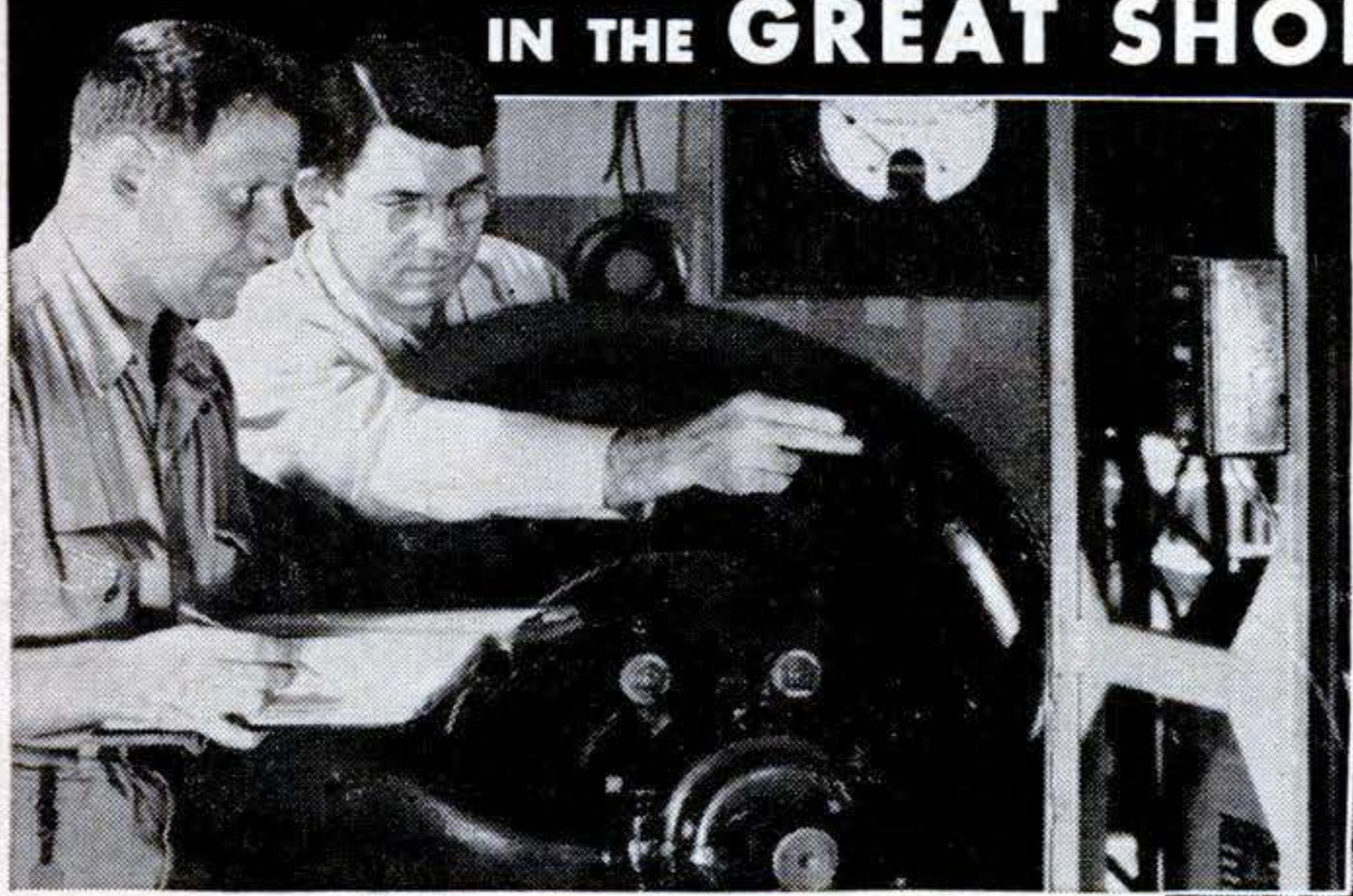

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Whether 17 or up to 45 years of age, don't be satisfied with a "no future job." Train the Coyne way for a better job in *Electricity-Electronics—a field that offers a world of opportunities now and in the years ahead.* In industry—in the home—Electricity and Electronics are playing a vastly greater role than ever before. New developments and fabulous growth are creating increasing job opportunities.

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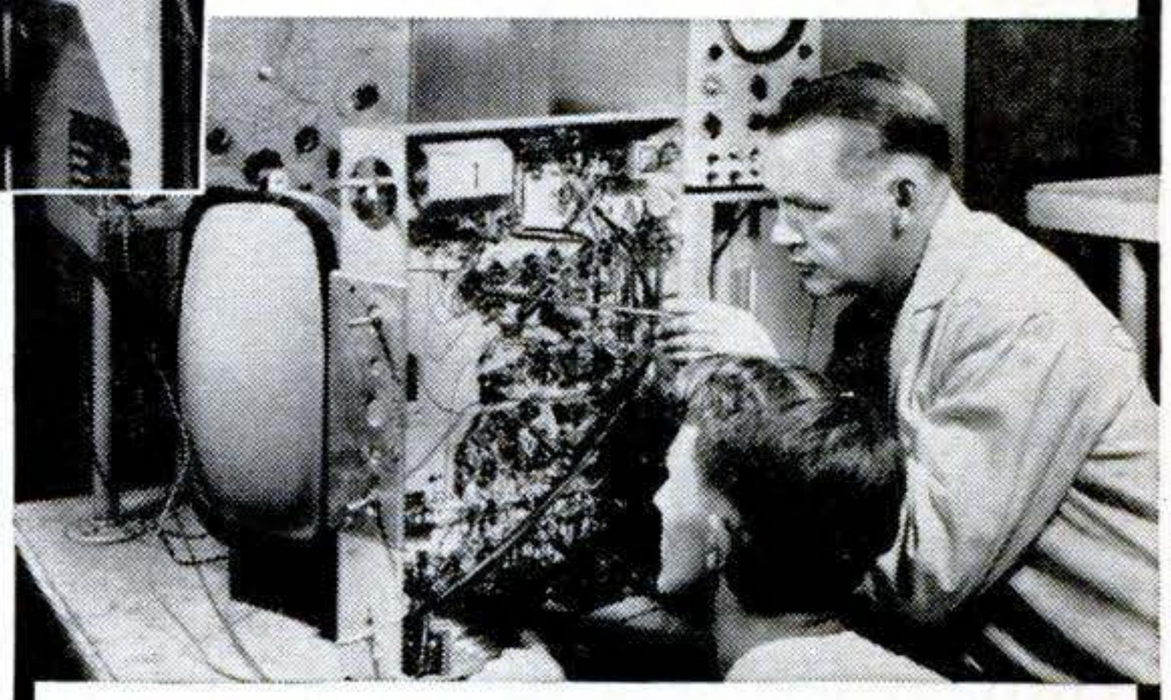

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Great opportunity for a good job or your own business in one of America's fastest growing industries! New stations by the hundreds . . . new sets by the millions . . . and now Color TV . . . all means greater opportunities in Sales and Service. Separate courses in Radio-Television or in combination with Electricity-Electronics available. Coupon brings details.

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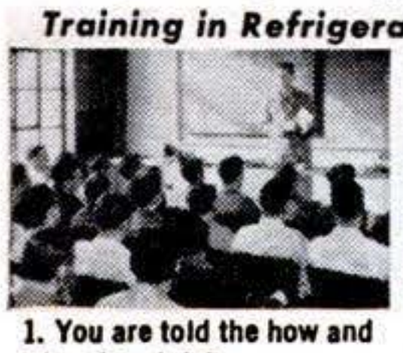

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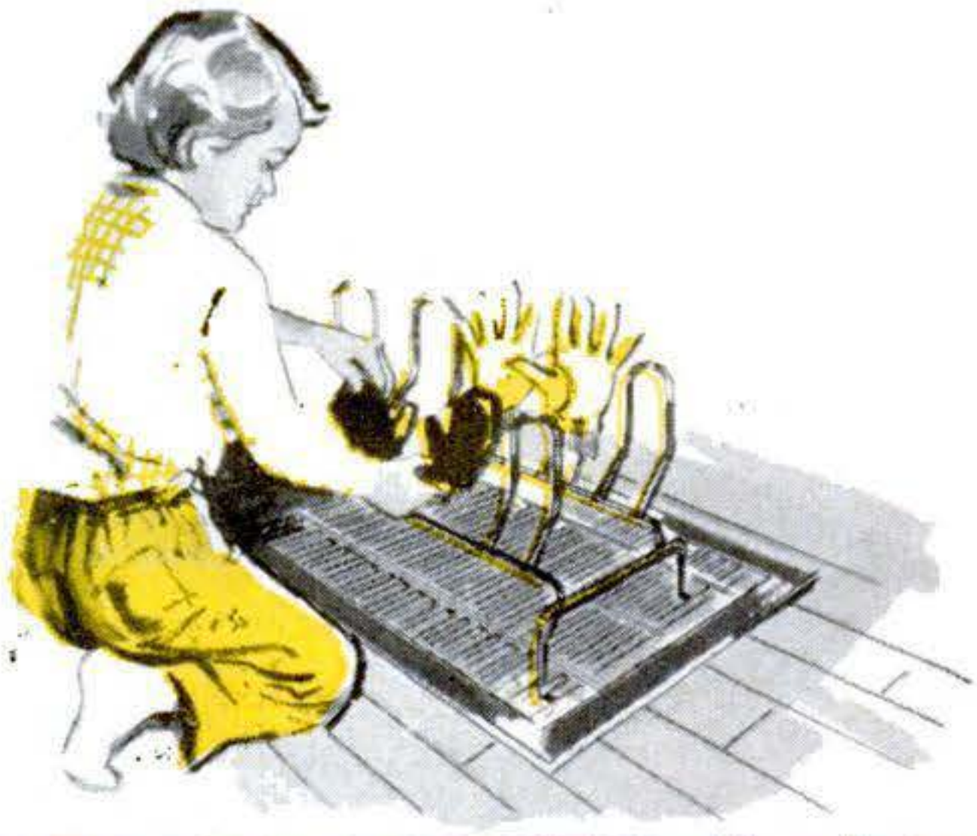
Keeping the Home Shipshape

TO DRIVE CUP HOOKS FAST, start them by hand and then use a hand drill. Tighten a screw eye in the drill chuck, slip the eye over each hook and turn the drill slowly and evenly.

AN OFF-SIZE CORK can be fitted into a smaller opening. Cut two wedge-shaped slots crisscross in the bottom. Widen and deepen them until the cork can be pressed into the opening easily.

IF A DOOR BINDS, work it back and forth over coarse sandpaper until it swings freely. Thumbtack the paper to the sill or overhead frame at the spot where the door tends to stick.

A HEATED BOWL or pan turned upside down over the butter dish speeds up sandwich-making. In a few minutes the butter is soft enough to spread easily on the bread.



DRYING WET GLOVES AND MITTENS will go faster if warm air can circulate through them. Spread them over the loops of a portable shoe rack standing on a floor register or near a radiator.

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"I Got My Start in Music This 'TEACH-YOURSELF' Way"

...says famous orchestra leader

LAWRENCE WELK

Television Star of "The Lawrence Welk Show"

[MONDAY AND SATURDAY EVENINGS-ABC-TV]

I got my start in music with a U.S. School Course. How easy it is to learn to read notes and play music this "teach yourself" way! In fact, this school did so much for me that I enrolled my two daughters.

Lawrence Welk

FROM FARM TO FAME. Above are Lawrence Welk and his famous "Champagne Music" orchestra of TV fame. When Welk was a farm lad, a U. S. School of Music Course taught him to read and play music in his spare time.

And Here's What Other Students Say

High School Boy Learns Very Quickly

"Couldn't play a note. Now play at parties. All my friends were surprised and asked me how I learned so quickly."—Bobby Smith, Grove Hill, Ala.

"How Happy I Am"

"How happy I am. I play for parties, entertainments. Never once thought I would be able to play the piano. Thanks a million!" — Cora Franklin Duke, Bumpass, Va.

"Friends Were Amazed"

"Didn't know a note on piano. In a short time I could play simple hymns. Friends were amazed. Now entertain at parties, play at church." —Samuel Moses, Mt. Vernon, Tenn.

You, Too, Can Play Your Favorite Instrument— Even if You Don't Know a Single Note of Music Now! Start Right Out Playing Real Pieces by NOTE.

WHY are you cheating yourself of the thrills of playing music? You think it's "too hard" to teach yourself? You can't afford private lessons? The nearest teacher is too far away? It would take "too long" to learn?

Over 900,000 people have found a simple answer to these difficulties. One of them was a farm boy named Lawrence Welk. Early in life he showed a love of music, and by 13 had learned to play his father's old "squeeze box" by ear. After years of farm labor, came the day he was rewarded with a modern accordion. He enrolled in the home study Course of the U. S. School of Music and was soon playing real music by note. Thus he started on the road that led to the present triumph of Lawrence Welk and his "Champagne Music" on ABC-TV.

What Music Can Do for YOU

You may simply want to learn to play for the sheer joy of it. The fun of entertaining your friends — of being invited to play at parties, where you meet interesting people, build your self-confidence. The pleasures of *appreciating* music more.

Regardless of what YOU want out of music, here's the easy way to get it! In just a few weeks, you can be playing REAL MUSIC on your favorite instrument. Not by any "trick" method. But actually reading and playing real sheet music—so confidently your friends will be amazed!

Enjoy All These Advantages

No boring scales and exercises. Lessons consist of delightful songs, hymns, waltzes, etc., with simple how-to-play-it directions and large clear pictures. Learn in the privacy of your own home, in spare time. None of the inconvenience and personality problems of having a private teacher —and costs only about a TENTH as much. Everything is so clear—so easy to understand—even youngsters "catch on" right away. Whole family can learn for price of one. Mail coupon now.

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Let us SHOW you why our way to learn music is so EASY—and so much fun! See why our method has been so successful for 59 years. Mail the coupon for our valuable 36-page *FREE BOOK*. No obligation, no salesman will call on you. It can mean *so much* to you for the rest of your entire life—if you will mail the coupon TODAY! **U. S. SCHOOL OF MUSIC, Studio A151, Port Washington, N. Y.** *Reduced prices on instruments to our students.*

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- ☐ Steel Guitar
- ☐ Violin
- ☐ Piano Accordion
- ☐ Saxophone
- ☐ Trumpet, Cornet
- ☐ Pipe, Hammond, Reed Organ
- ☐ Tenor Banjo
- ☐ Ukulele
- ☐ Clarinet
- ☐ Trombone
- ☐ Flute
- ☐ Piccolo
- ☐ Modern Elementary Harmony
- ☐ Mandolin
- ☐ Practical Finger Control

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City..... State.....
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Learn at Home IN YOUR SPARE TIME to Fix Electrical Appliances

To build a better future, get into a field where there's much important work and the security that comes from knowing a good trade. Servicing electrical appliances offers that OPPORTUNITY. Every wired home has an average of 8 electrical appliances. Up to 10 million new appliances are sold every year and owners pay well to keep them in repair. That's making a fast-growing need for trained men.

Start Soon to Earn $3, $4, $5, an Hour Extra in Your Spare Time

Start soon to fix electric toasters, clocks, fans, vacuum cleaners and other appliances for neighbors and friends. Work in your basement, garage or spare room. Pick up $3 to $5 an Hour *extra that way*. It's easy to increase your earning power—to pay for this training many times over with your spare time earnings.

Learn and Earn with Multi-Use Tester Built with Parts We Send

This course includes the parts to build a portable, sturdy Appliance Tester that helps you locate electrical defects quickly and easily. You use it to learn and do actual electrical appliance repair jobs. If you want better pay learn this good trade. No need to give up your present job. You can train at home in your spare time for only $2.50 down and $5.00 a month. A small price to pay for increased earnings, a more secure future. Paste coupon below on a 2c postal or mail in envelope for free book and sample lesson. Address National Radio Institute, Dept. BA7, Washington 9, D.C.

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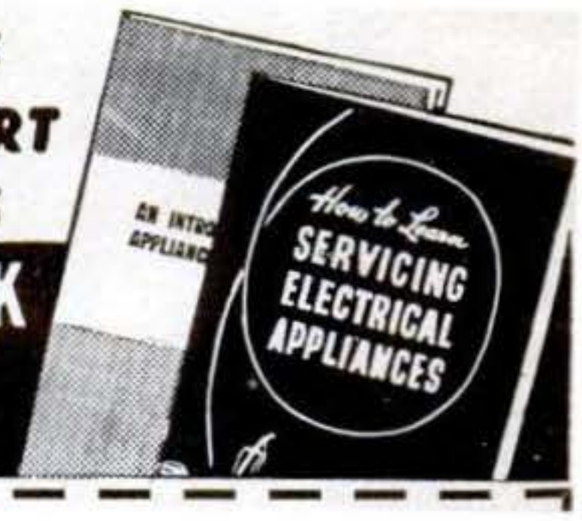

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You ought to know...

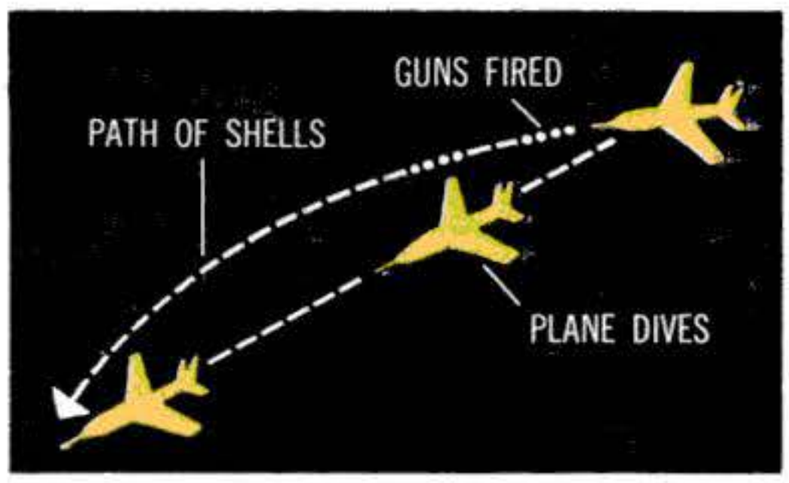
Plenty of Shakespeare is good for budding scientists and engineers. That's the growing feeling in both industrial and academic circles about careers you associate almost exclusively with mathematics.

If you recall the article in our November issue (p. 173) on "The Machine That Indexed the Bible," you'll know why there's such an emphasis on language training for scientists. Here the scientist had to "tell" a Univac how to cross-index the Good Book. A fellow not expert in his own tongue would be hopelessly lost trying to "talk" to today's electronic morons.

Engineering colleges now require candidates to have at least three years' credit in high-school English. Moreover, in the freshman college year, English composition and literature are musts. Engineering students learn these language arts just as well as other students do, a recent study proved.

Then there's this angle: A scientist or engineer who can't communicate his ideas fluently to his colleagues is a cripple. He might as well be working in a vacuum. But the real convincer about the desirability of languages for engineers is flatly laid on the line in a little booklet by General Motors entitled "Can I Be an Engineer?" It says: "English . . . may be the deciding factor when it comes to promotion to an executive position."

It finally happened. A jet fighter caught up with its own shells and shot itself down. A Grumman test pilot, wringing out the new Navy F-11-F1 at 880 m.p.h., fired his 20-mm. cannon and then dived—straight into flying steel. Although the shells actually were moving faster than the plane, their trajectory was curved and they moved in a longer path. So the plane and shells met as diagrammed at left. Luckily, the shells contained no explosive and the pilot crash-landed his shot-up plane, escaping hurt but alive.



Chicken preserved with antibiotic—the same kind of wonder drug the doctor prescribes when you are sick—should be at your grocer's soon. The Government has okayed the use of Pfizer's Biostat to keep poultry fresh longer, and the big poultry packers were ready to start dipping their chickens in it last month. Antibiotic preservation is expected to save some of the billions of dollars lost through spoilage, and may even reduce the price of meat. So far, poultry is the only food for which antibiotic preservation is permitted here, but in Canada fish treated with aureomycin are being sold. And tests are being made on many other foodstuffs, including whalemeat—the antibiotic is injected by the

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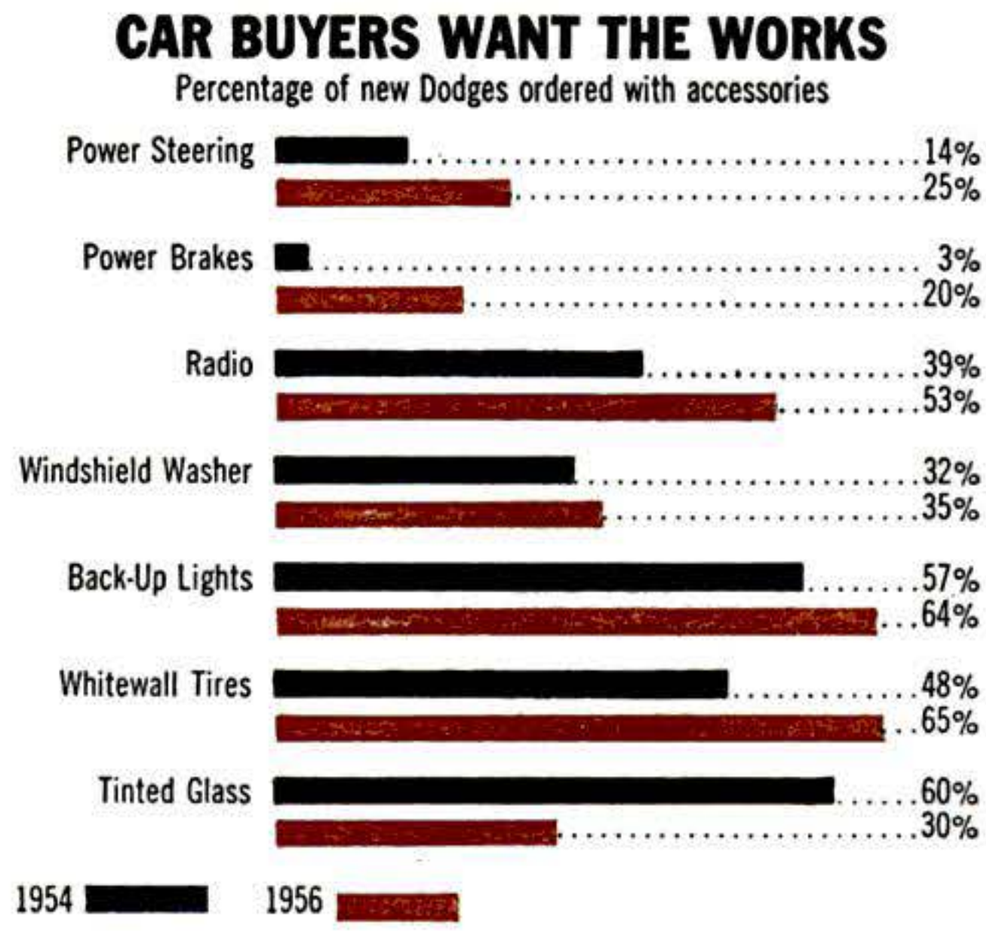
You ought to know...

harpoon that kills the whale. You do not eat the antibiotic because the heat of cooking destroys these chemicals.

A hamster caught a cold. This is big news in the discouraging war against mankind's commonest disease because the rodent is an excellent test animal. Until now the only animals that could be infected with cold virus were humans and chimpanzees, both expensive and difficult to experiment with.

The super de luxe model continues to grow in popularity among purchasers of new cars, Dodge sales figures indicate (see chart at left). Practically everybody orders a heater and automatic transmission—96 and 90 percent in '56, respectively. The big exception is tinted glass, which was ordered on 60 percent of '54 Dodges, but on only 30 percent of '56s . . . Fuel injection has Detroit by the ears. Everyone is fiddling with it, few anywhere near production like Chevrolet. In a smart move to work out the bugs before public sale, Pontiac will build 1,500 fuel-injection engines starting this month—and put them in cars exclusively for dealer use. This will provide a hefty catalogue of results on actual field tests and hasten the repair of weak points. The engines will turn up 300 horsepower.



A bigger—and more expensive—boom in housing is ahead. Home shoppers will trade up to costlier but better homes (they may also have to pay more interest on mortgages). Builders will be busy keeping up with the demand. So conclude Drs. Leo Grebler, David M. Bland and Louis Winnick in a scholarly volume, "Capital Formation in Residential Real Estate." The next 25 years will see a record number of new households, requiring well over 1,000,000 new homes per year. And the two-house family may become common—the number of vacation homes doubled in a decade.

Although new houses seem to be expensive, they actually represent a smaller investment than they used to. The real purchasing power (canceling out inflation) of U.S. families has doubled since 1890, but the fraction of this purchasing power put into housing has dropped 40 percent. The economists noted a reversal in this trend recently, and they expect it to continue—people will spend more real income on homes.

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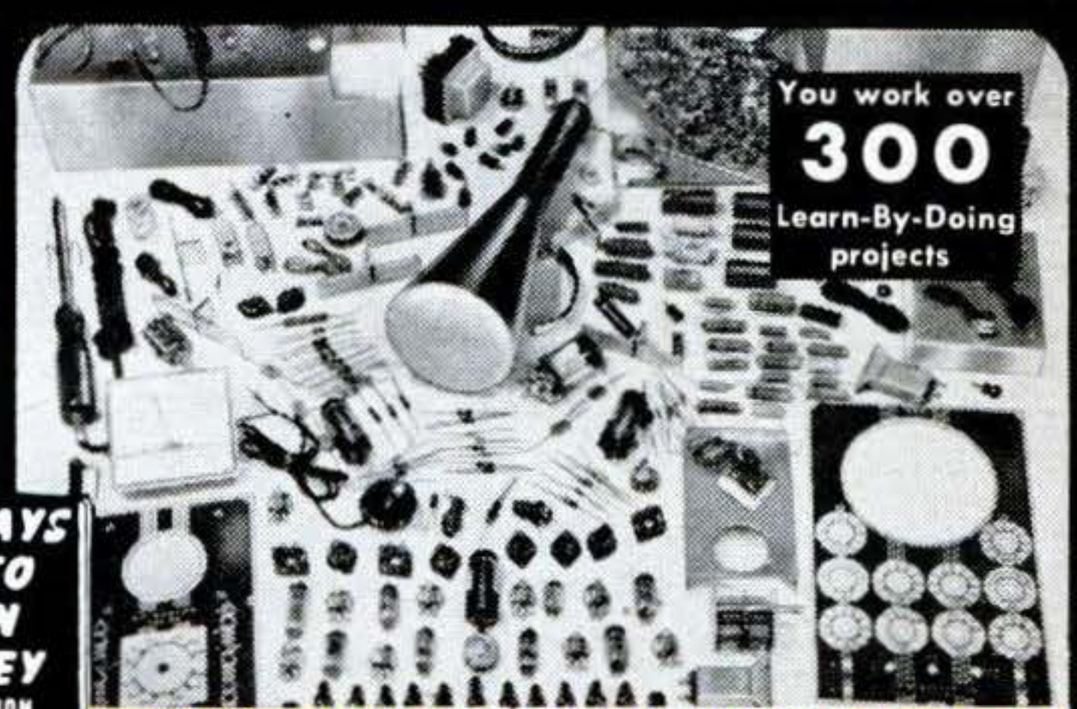

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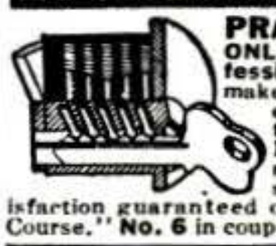

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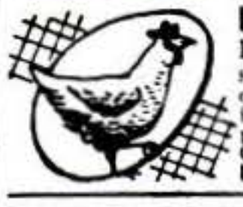

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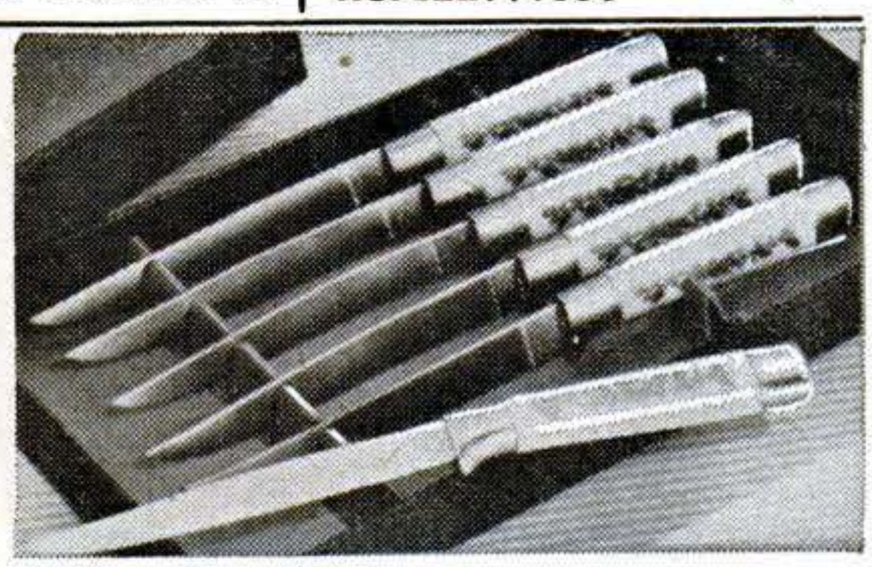

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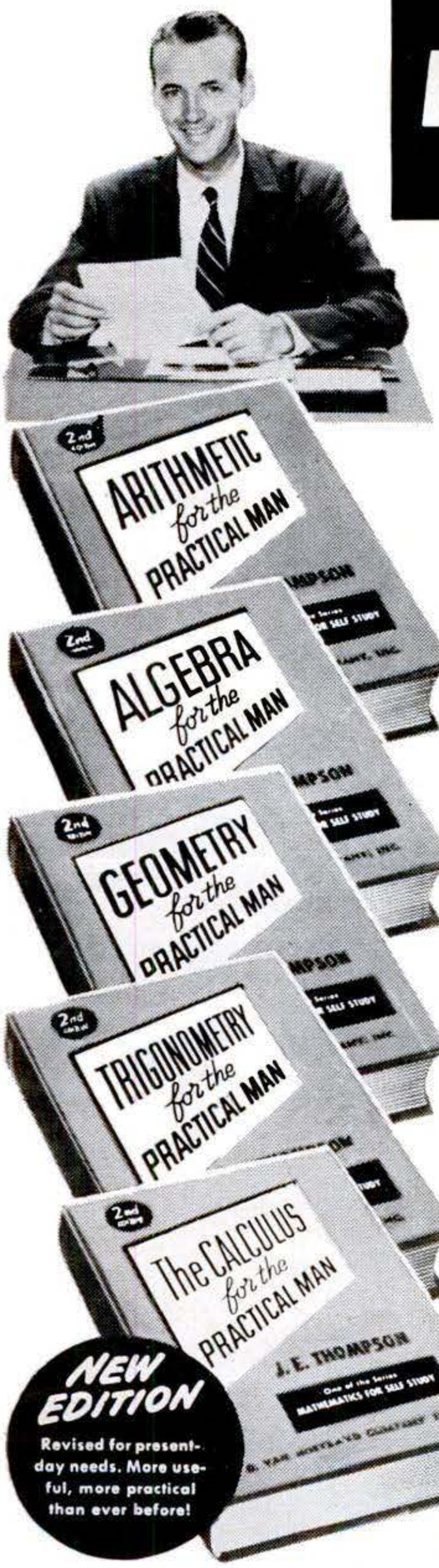

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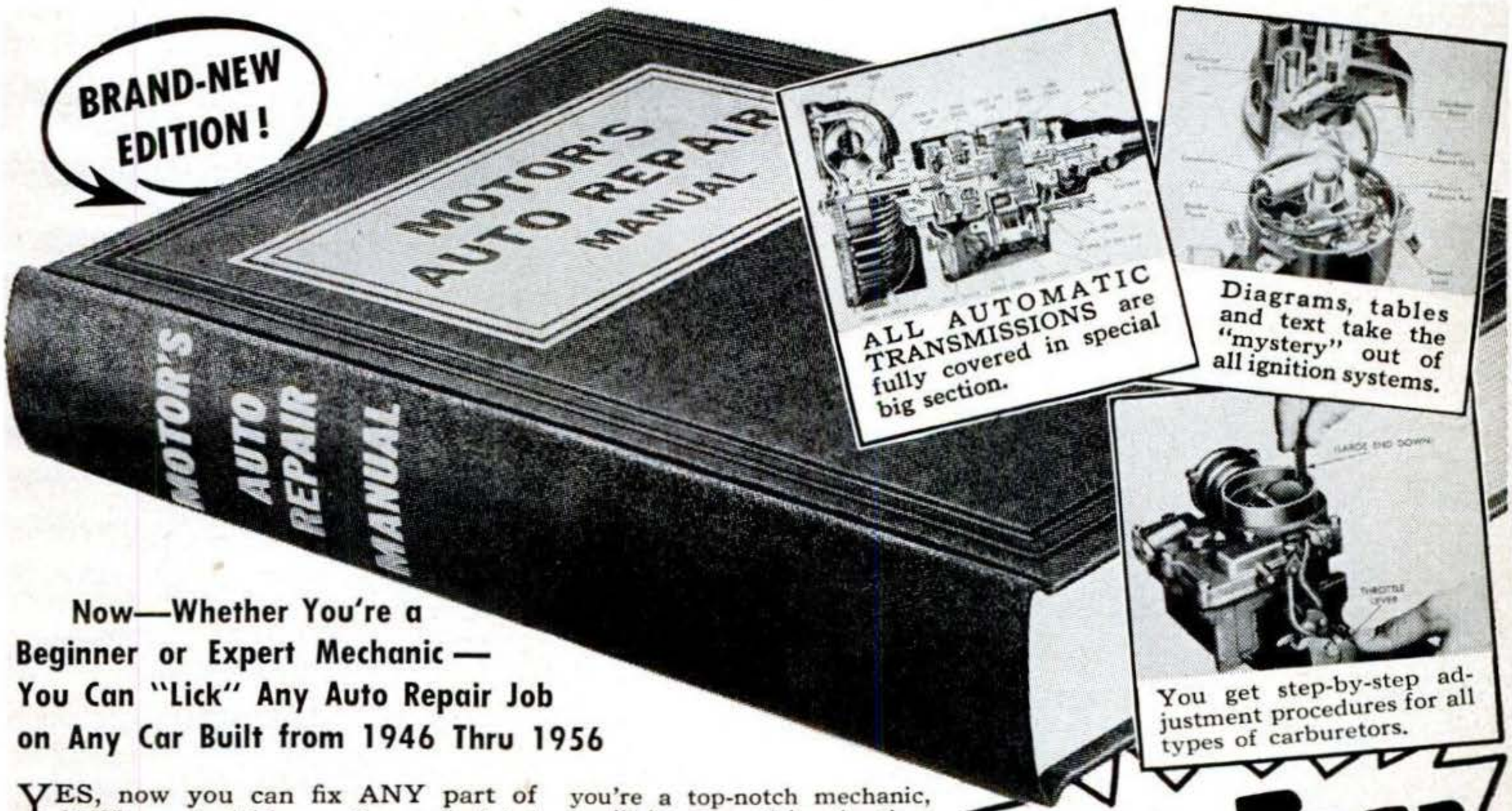

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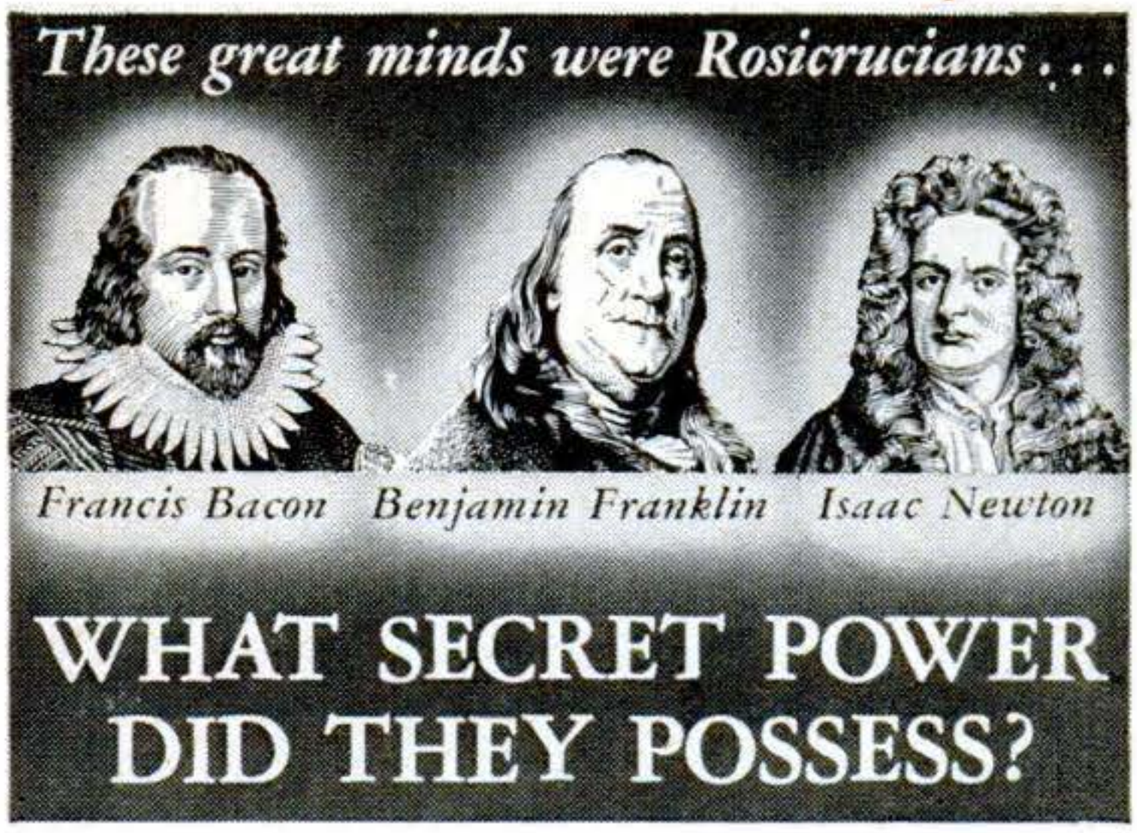

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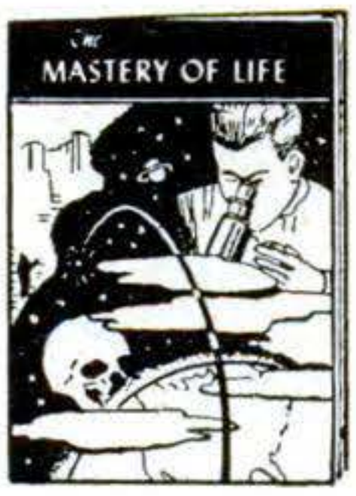

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By ED MITCHELL

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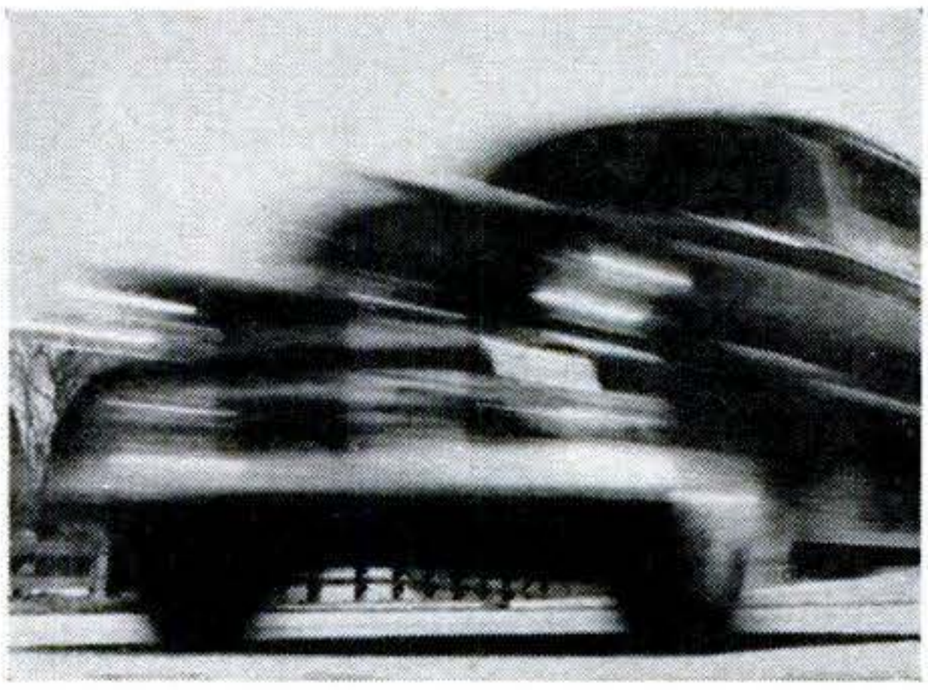

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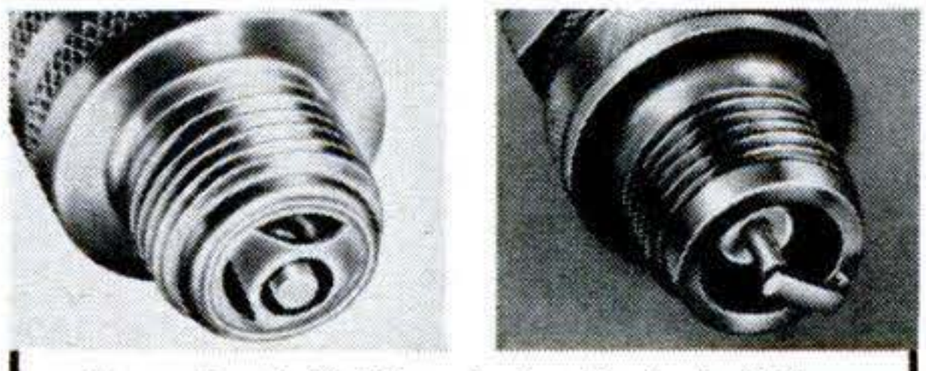

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You have nothing to lose! *BUT THE SUPPLY OF THESE PLUGS IS STRICTLY LIMITED. THE NICKEL ALLOY WHICH MAKES UP THEIR ELECTRODES IS HELD IN SHORT SUPPLY BY THE UNITED STATES GOVERNMENT. THIS WILL BE ABSOLUTELY THE LAST TIME WE CAN MAKE THIS OFFER! ACT TODAY!*

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"Although I did have a new set of spark plugs in my car before replacing them with your Power Plugs, the old plugs made my engine spit and gallop. Now it really runs smooth and starts a lot better, too." *R. O., Duluth, Minn.*

"I bought your plugs for my '54 Ford some time ago . . . as far as I can tell I am getting at least 8 miles per gallon better mileage. Also my Ford has far better pickup and horsepower. I have driven about 12,000 miles since purchasing the plugs and they are in as good condition as ever." *C. M., Avilla, Indiana*

"I replaced the equipment-type spark plugs in my Lincoln Continental with yours. With the old style plugs, I was getting approximately 15 miles to the gallon. During the first thousand miles of operation with Power Plugs, my mileage increased to 22 miles per gallon. This was an increase of 7 miles per gallon. In addition to the increased mileage, I was happy to notice much better idling and absolutely no stalling. Hills which I formerly took in second gear now present no problem in climbing with high gear. My heavy Continental used to lope away from signals; now it dashes away."

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"I'd say your plugs are well worth the price you ask, especially as I do not expect to have to buy a new set as long as I have my present car—a 1953 Mercury." *R. H. D., Chicago, Ill.*

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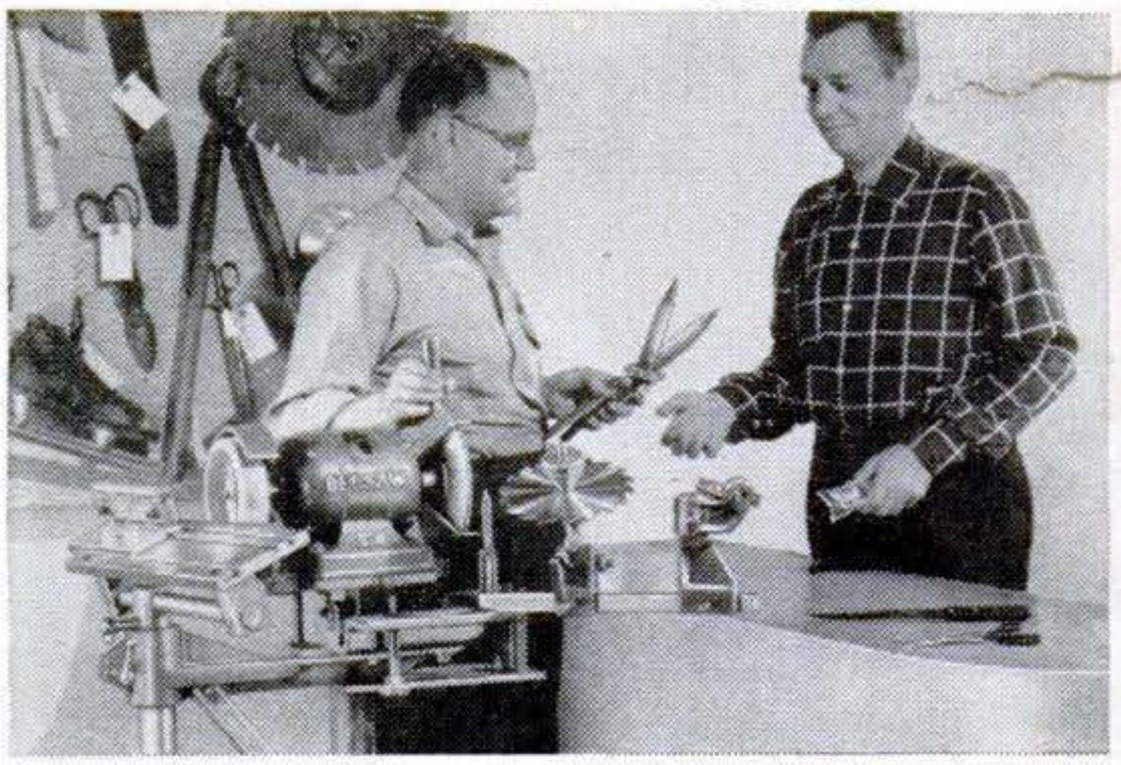

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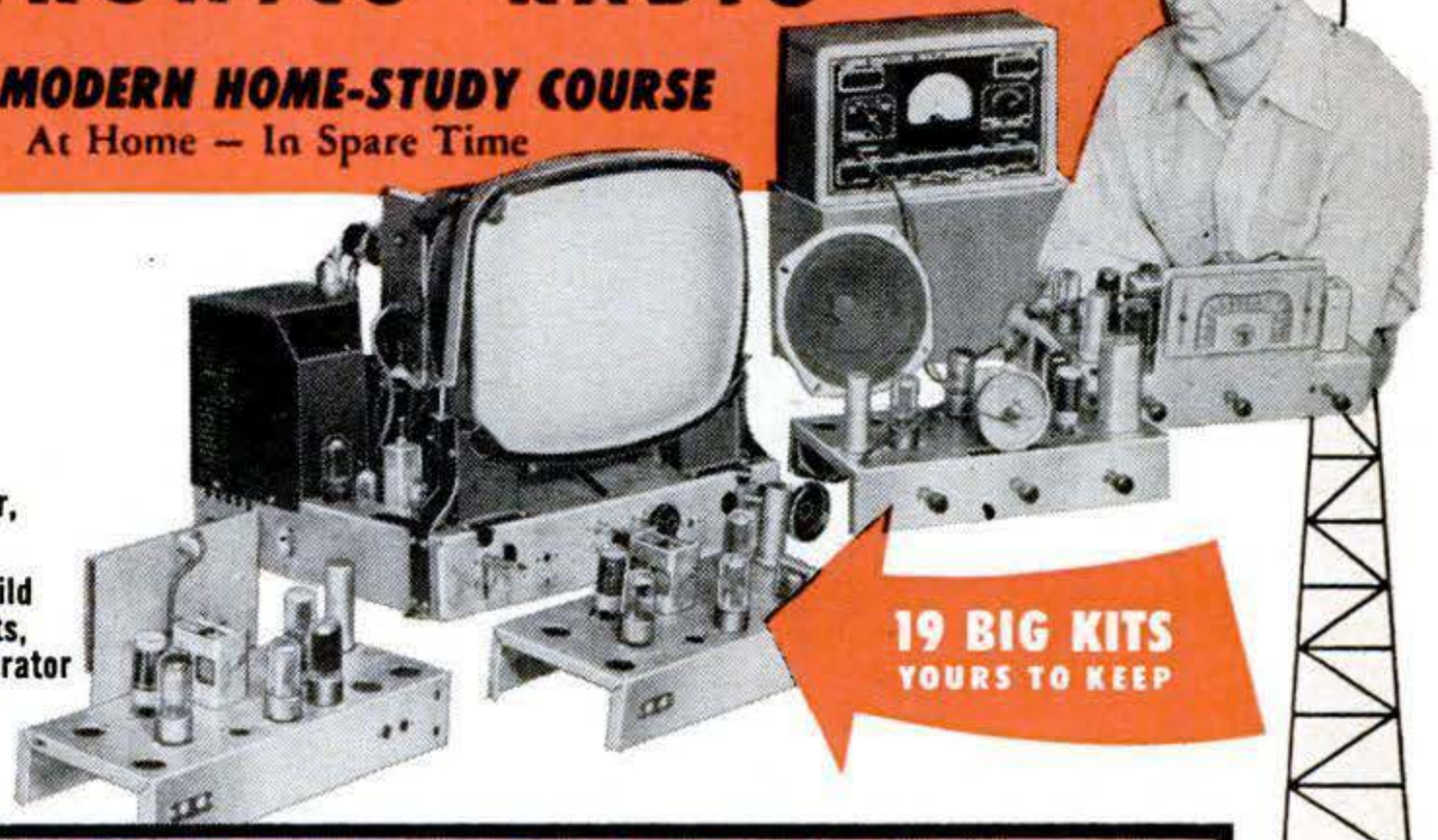

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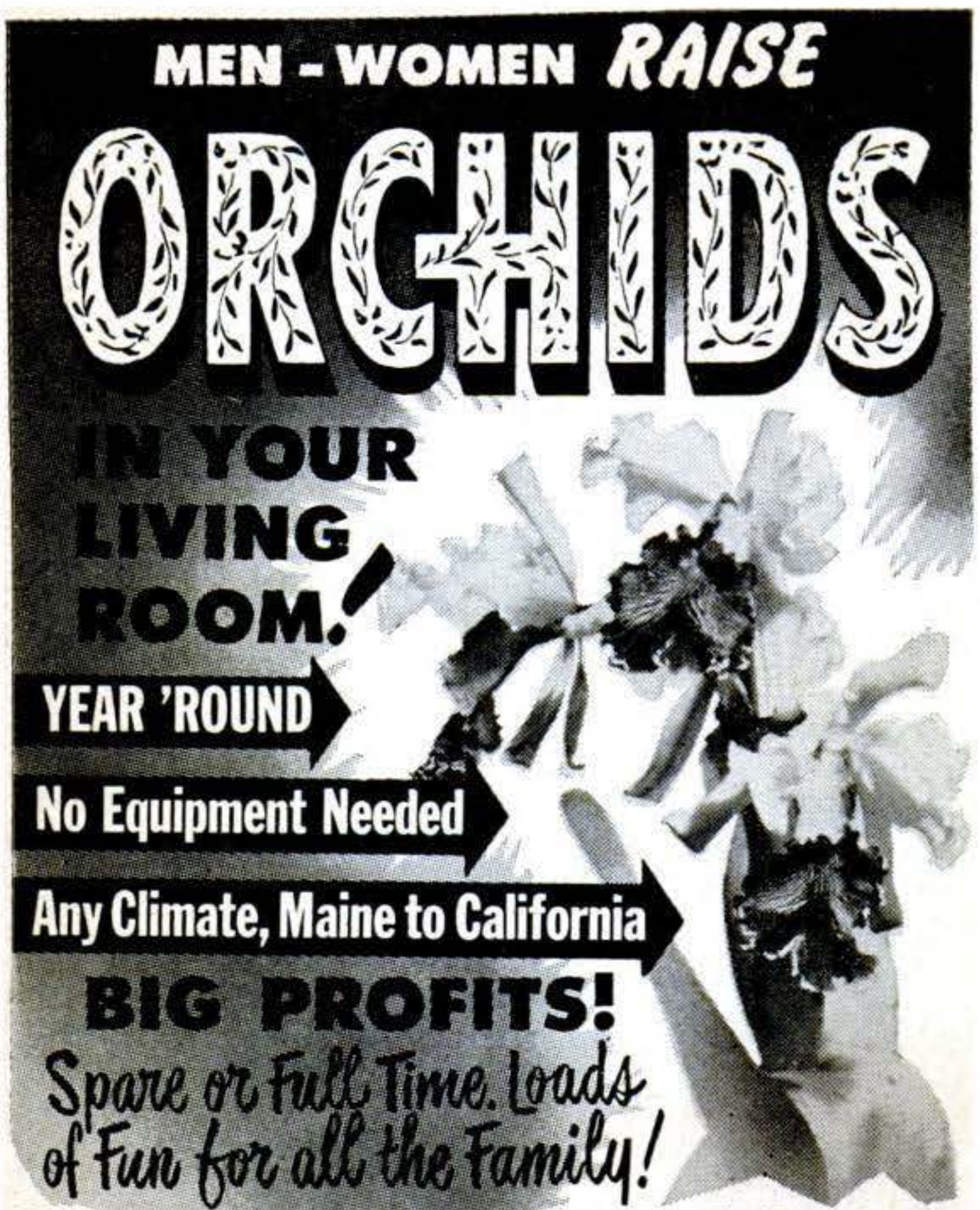

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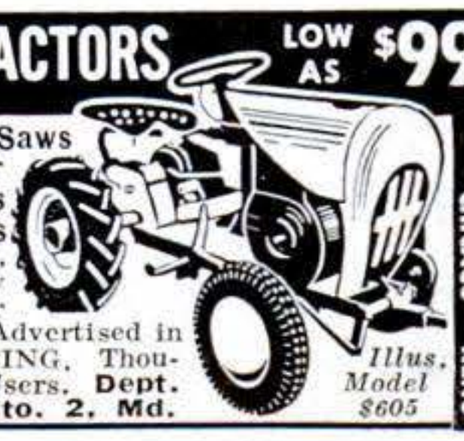

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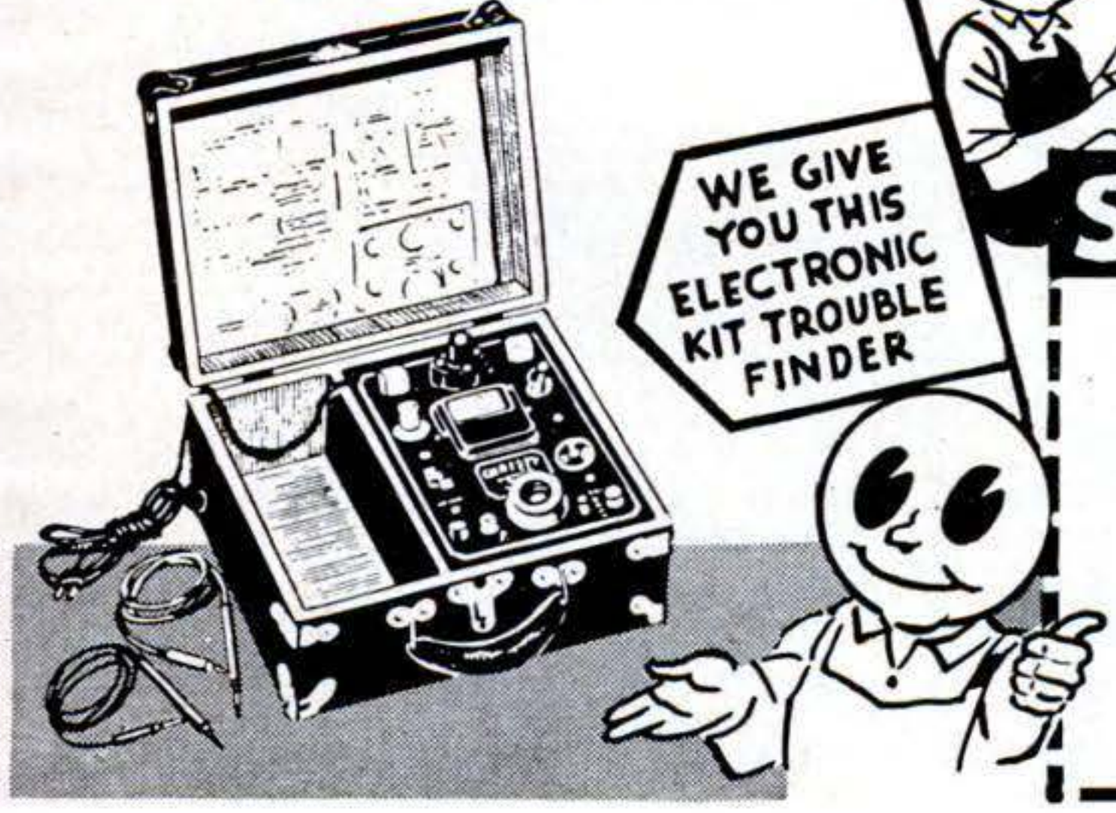

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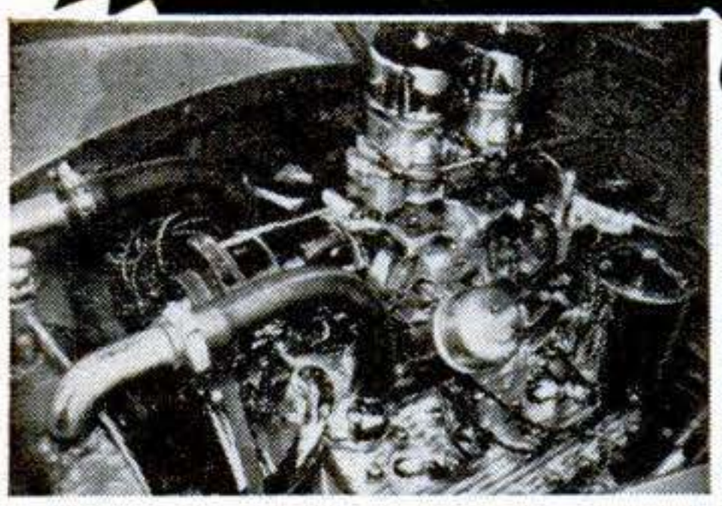

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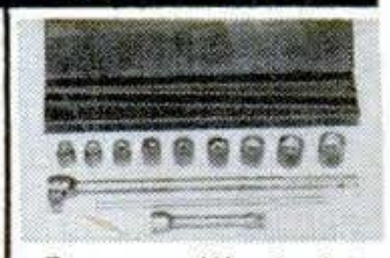

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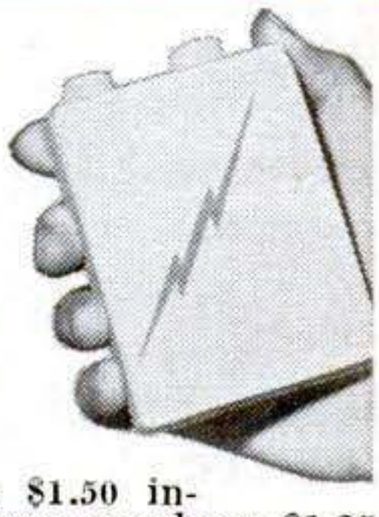

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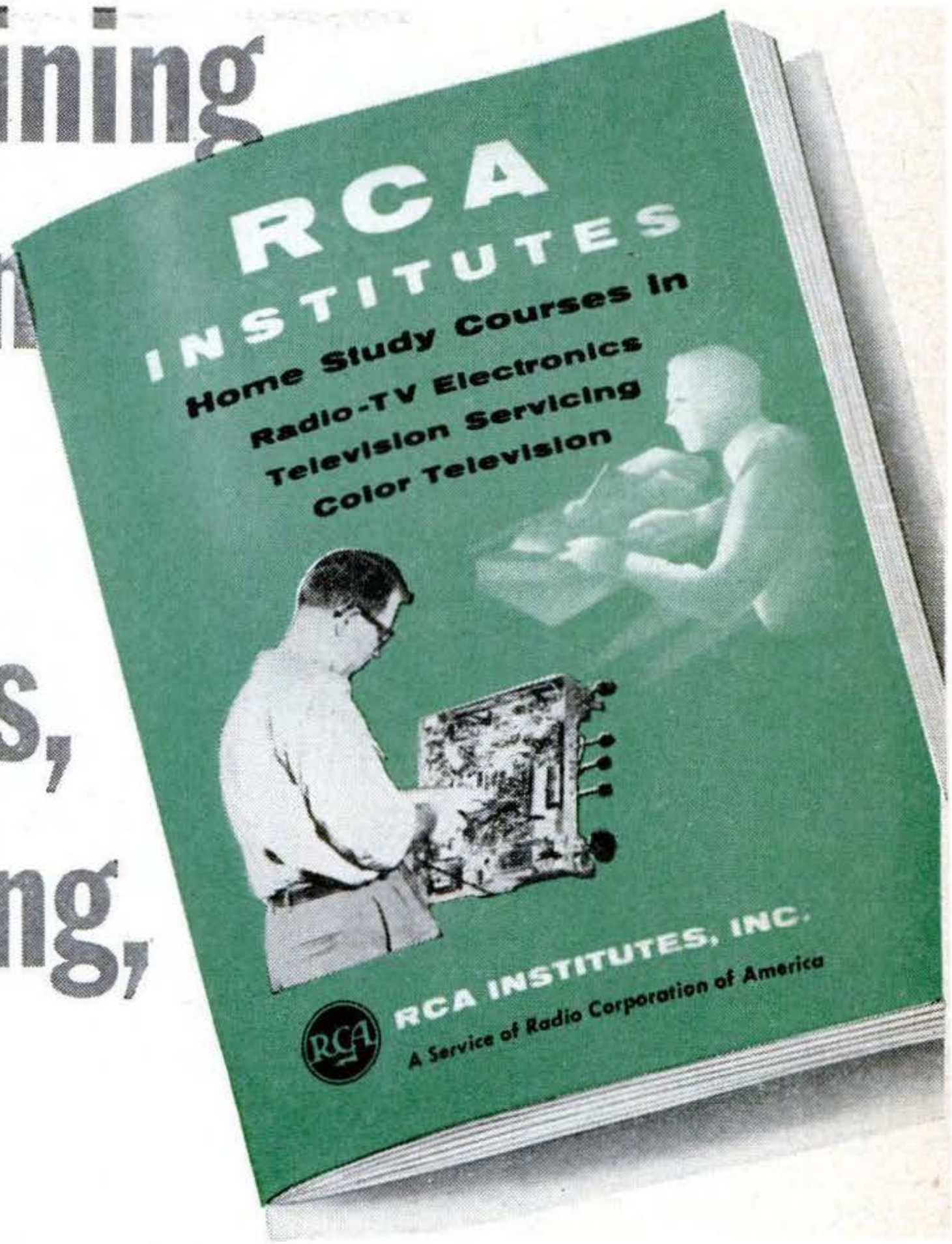

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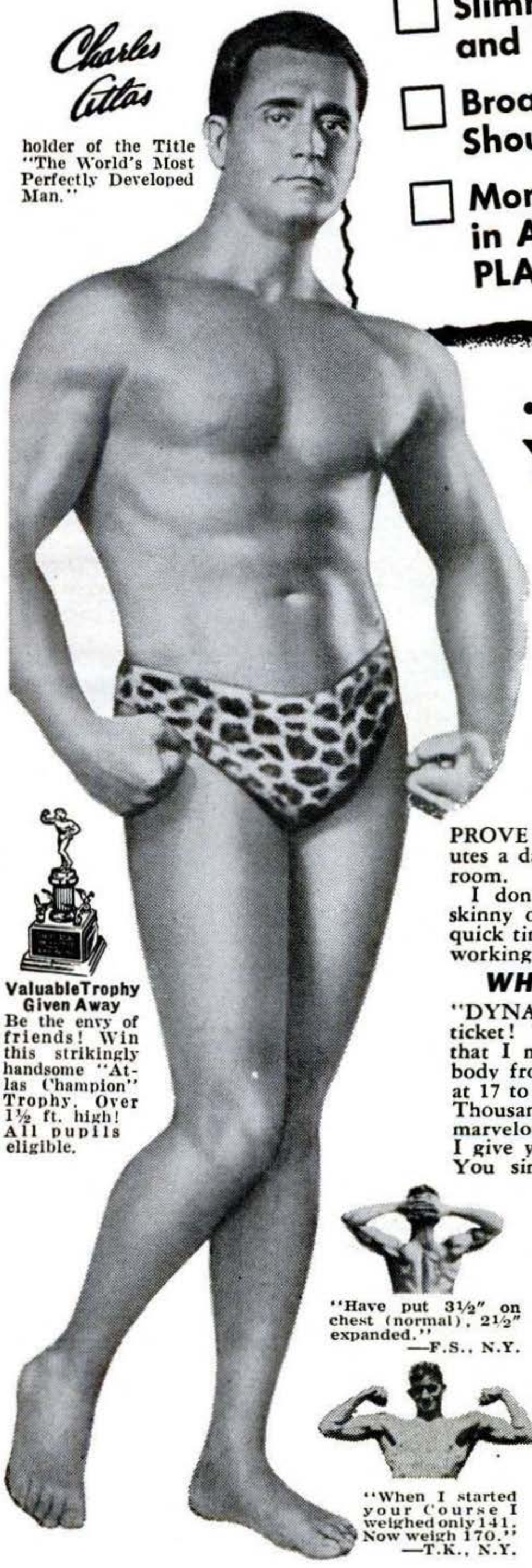

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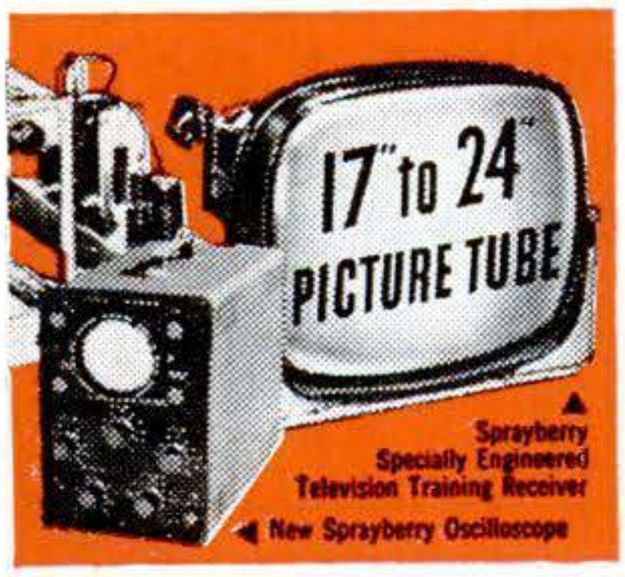

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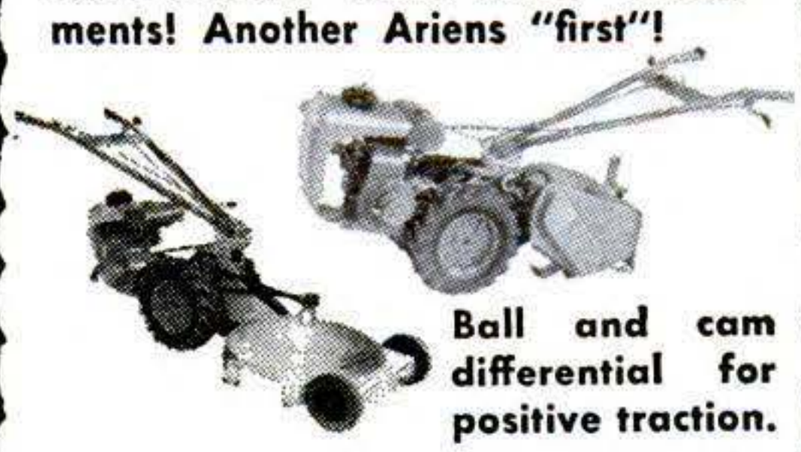

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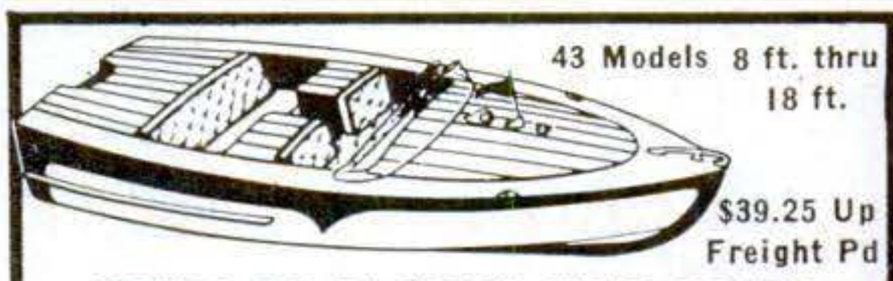

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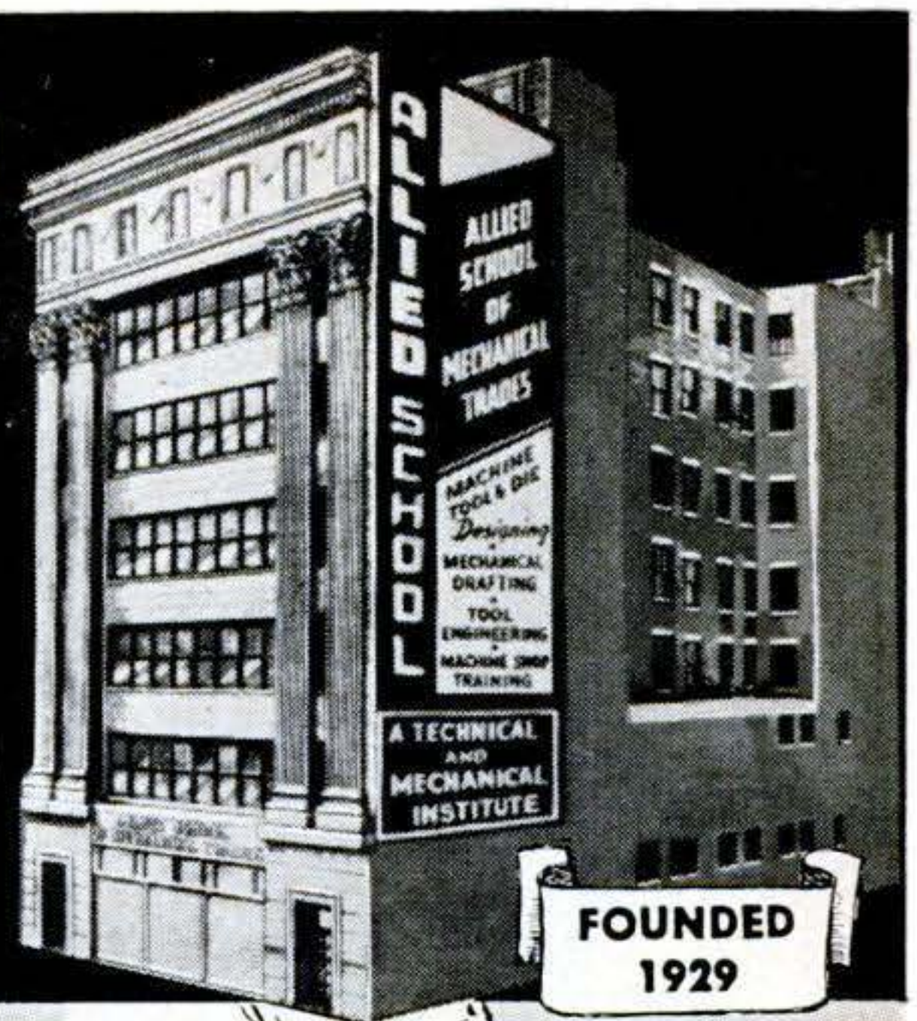

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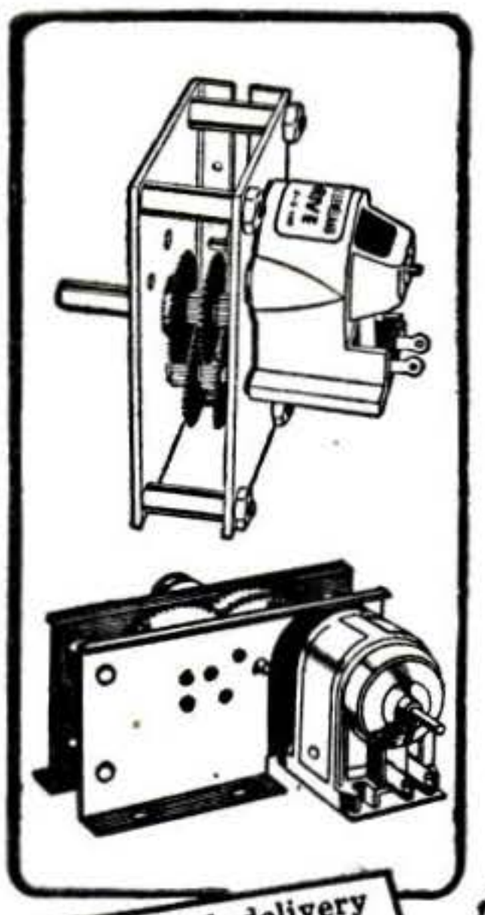

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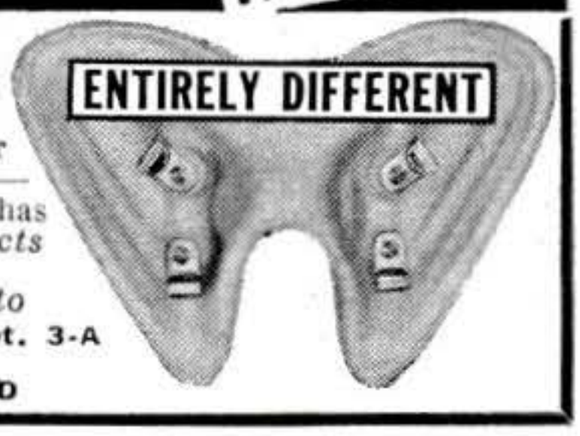

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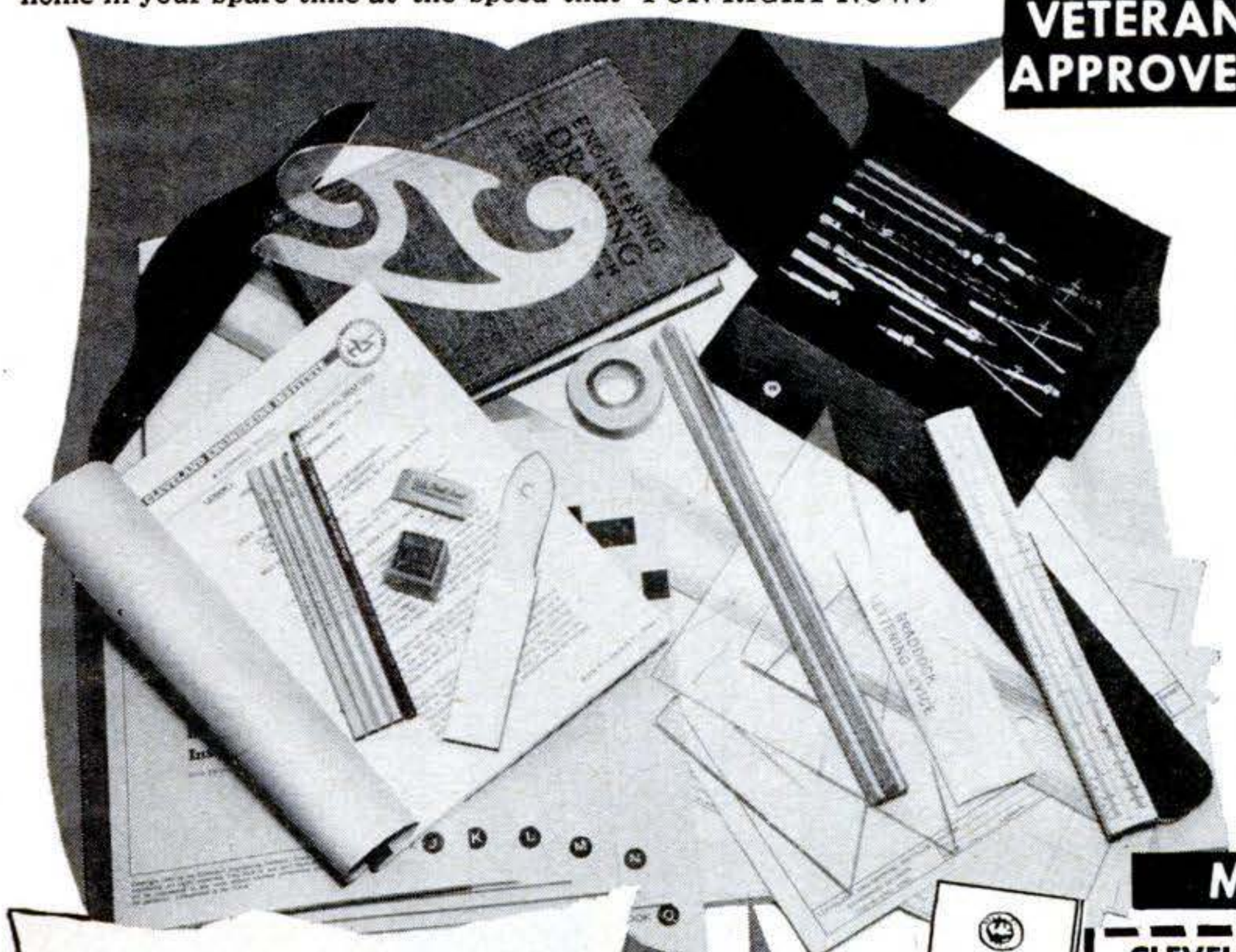

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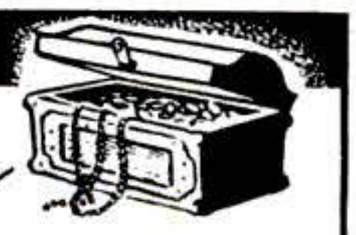

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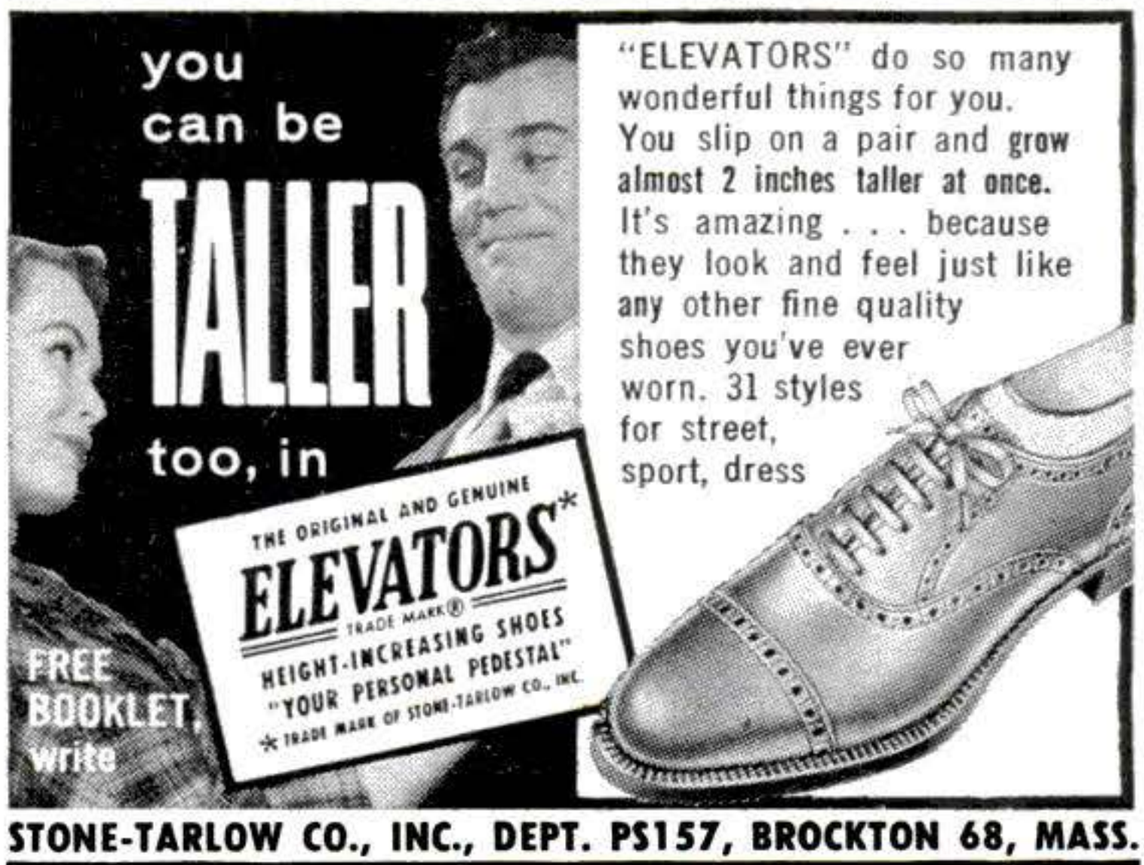

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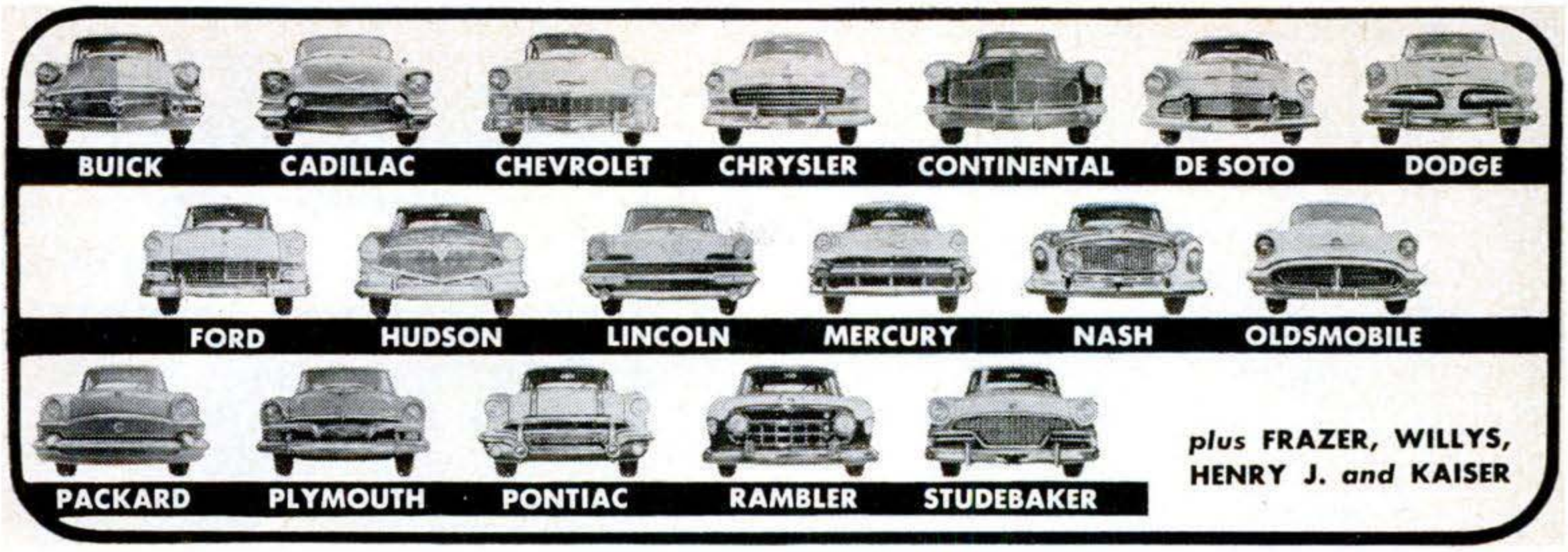

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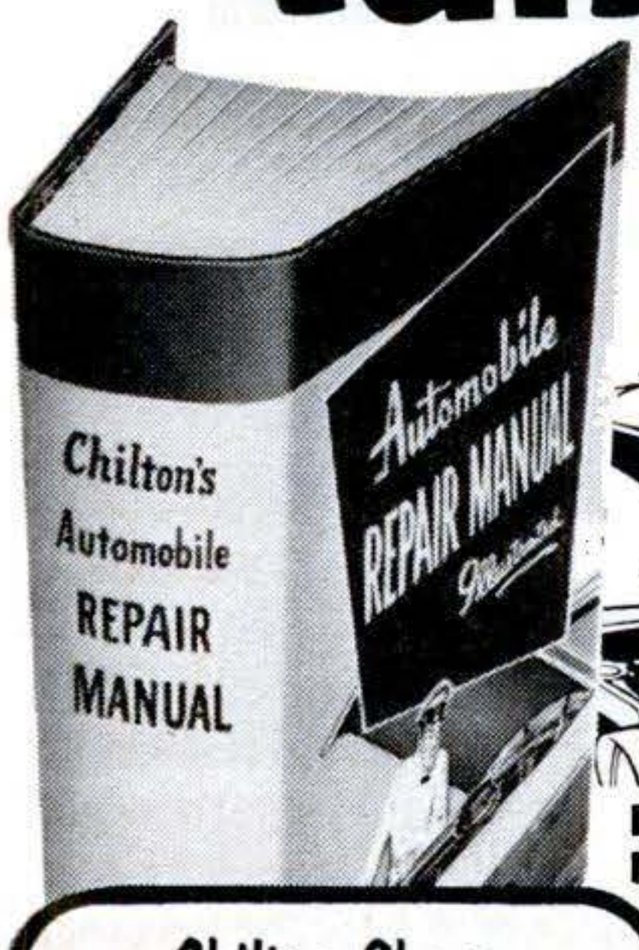

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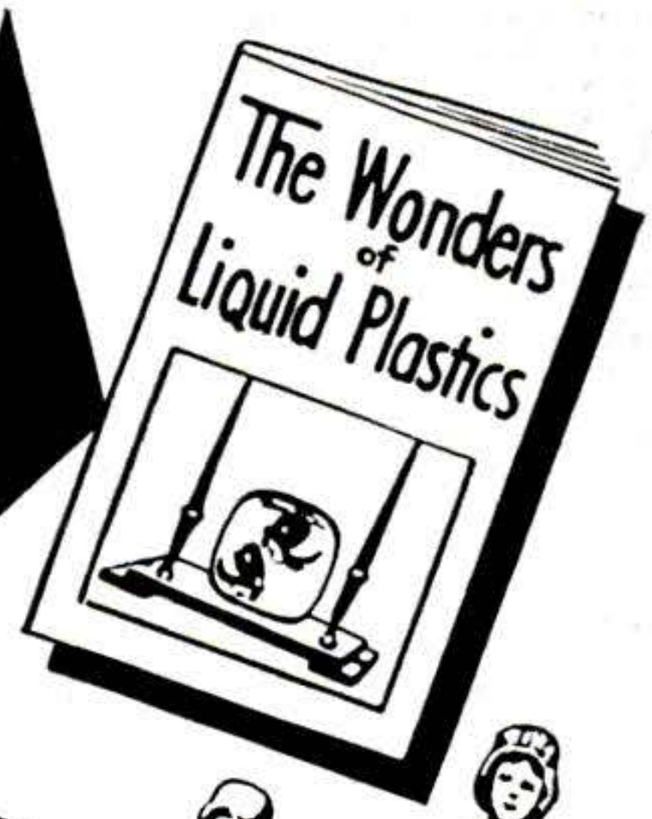

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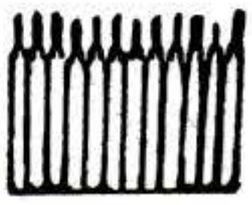

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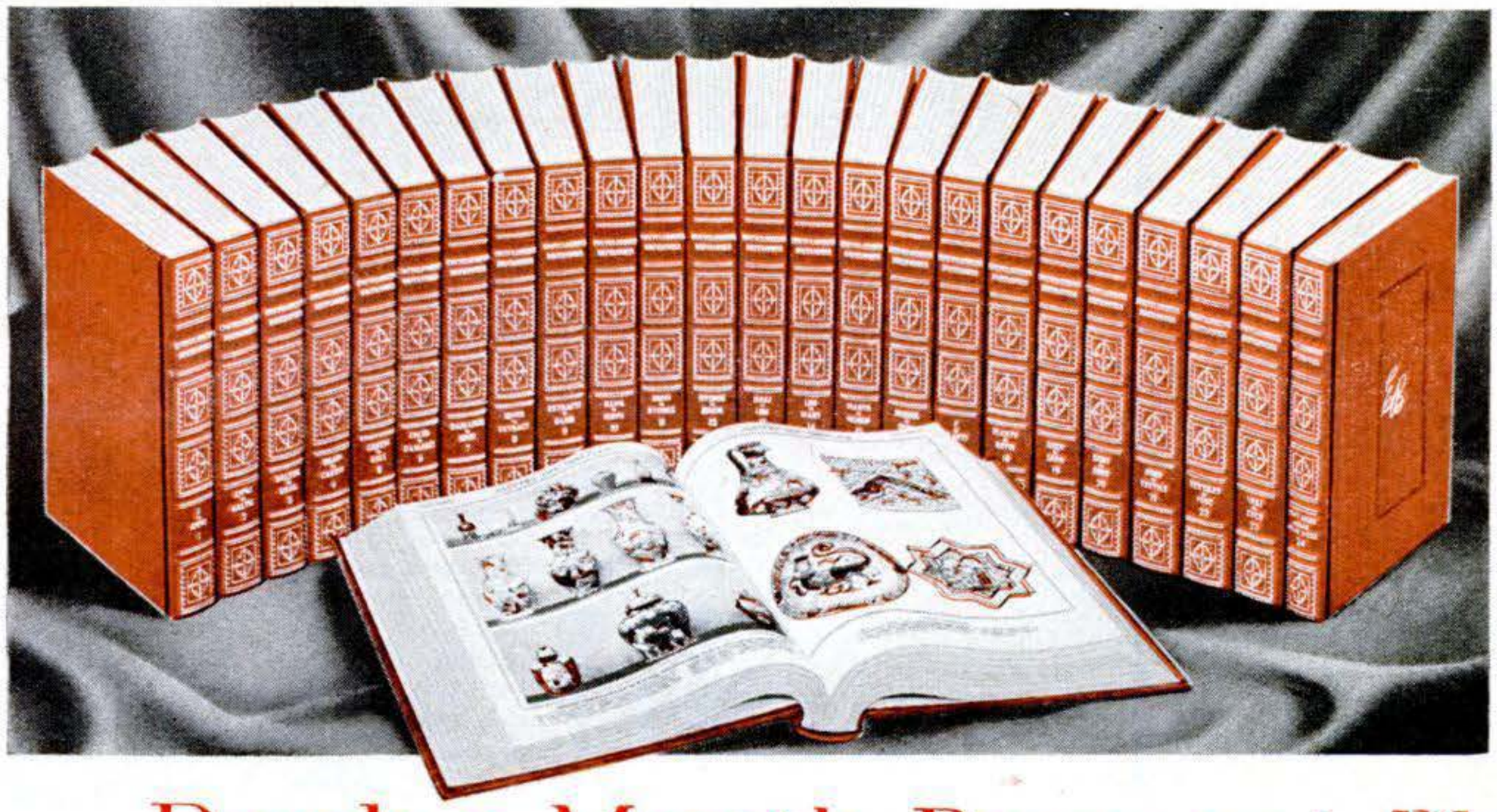

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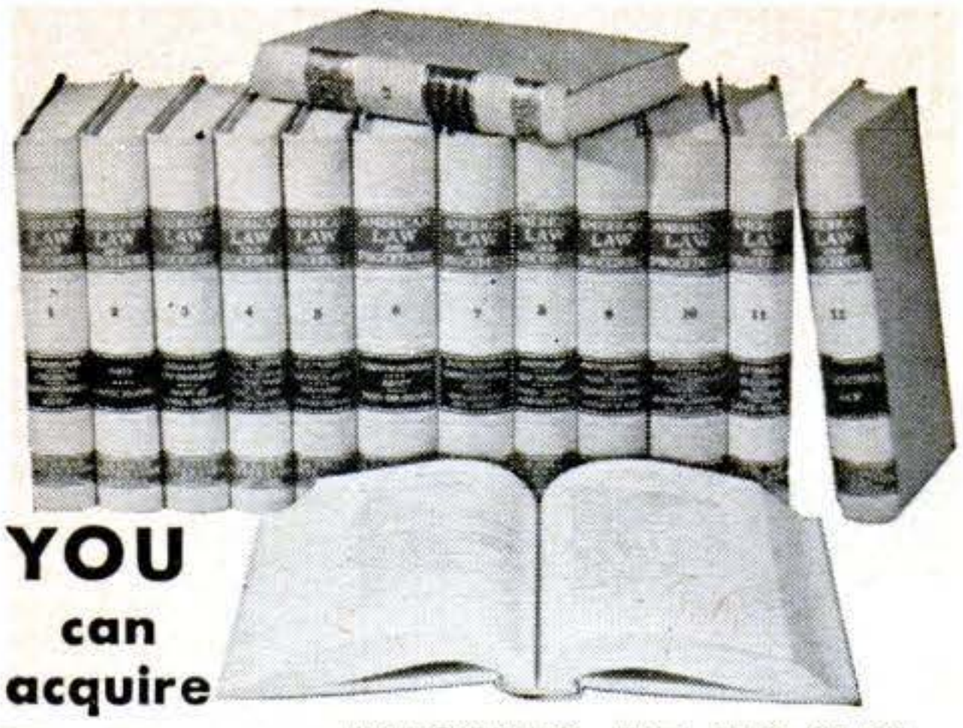

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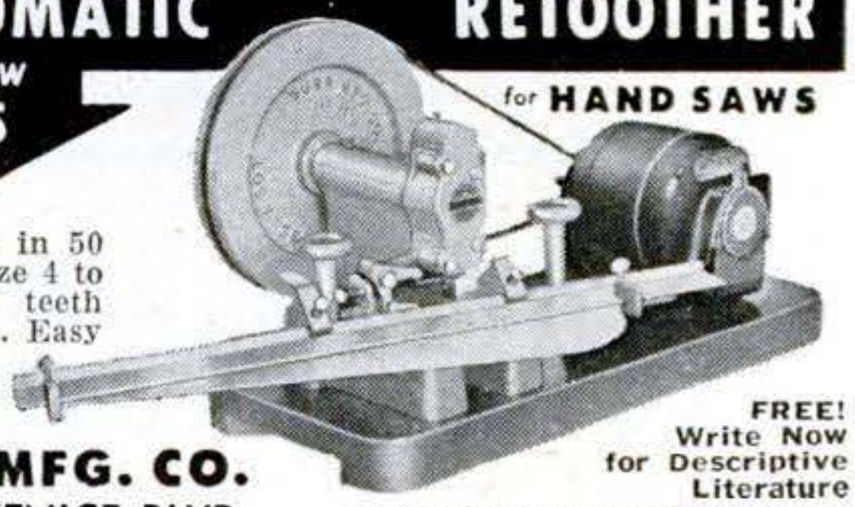

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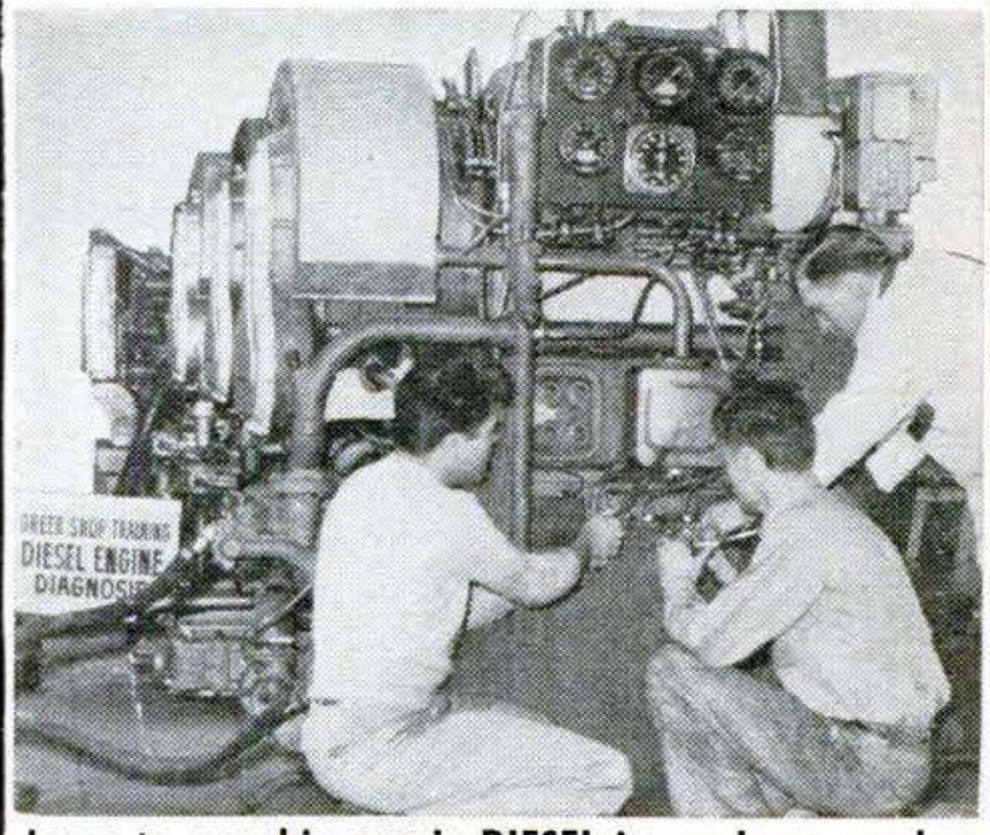

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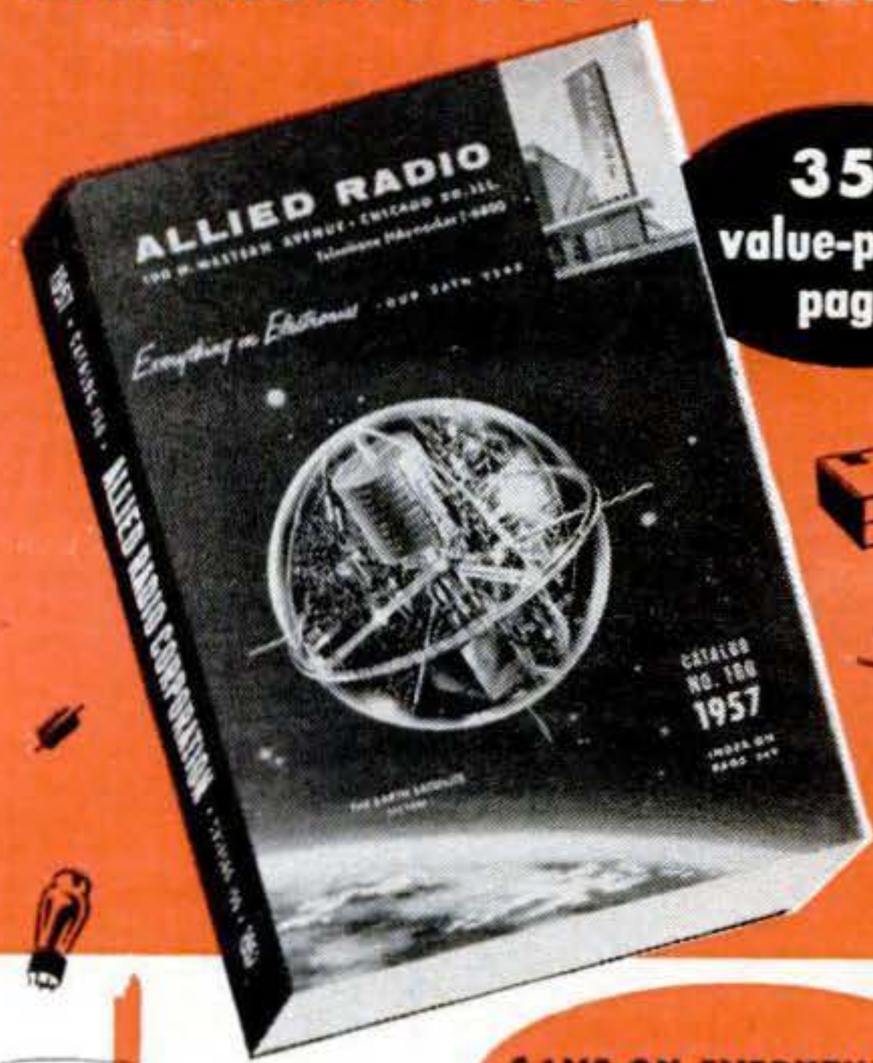

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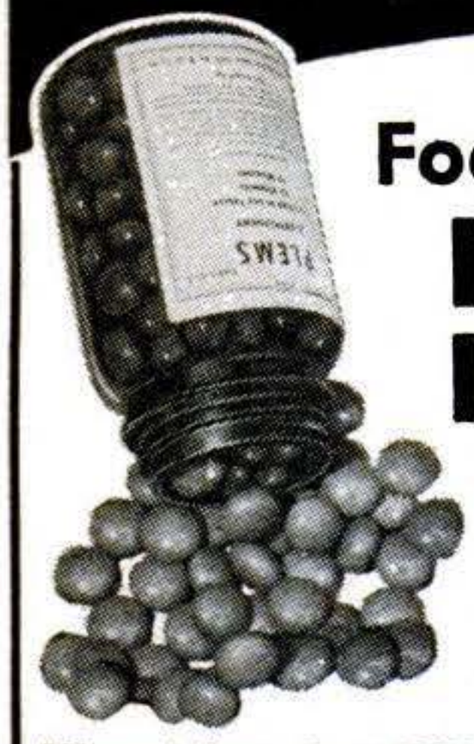

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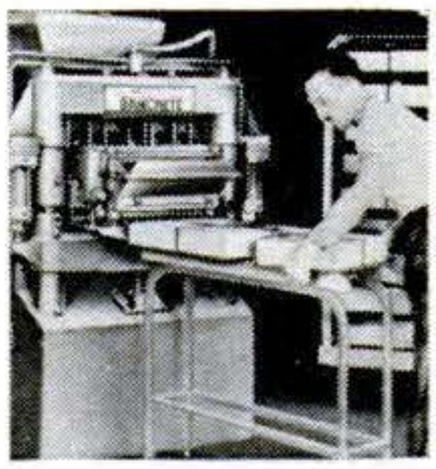

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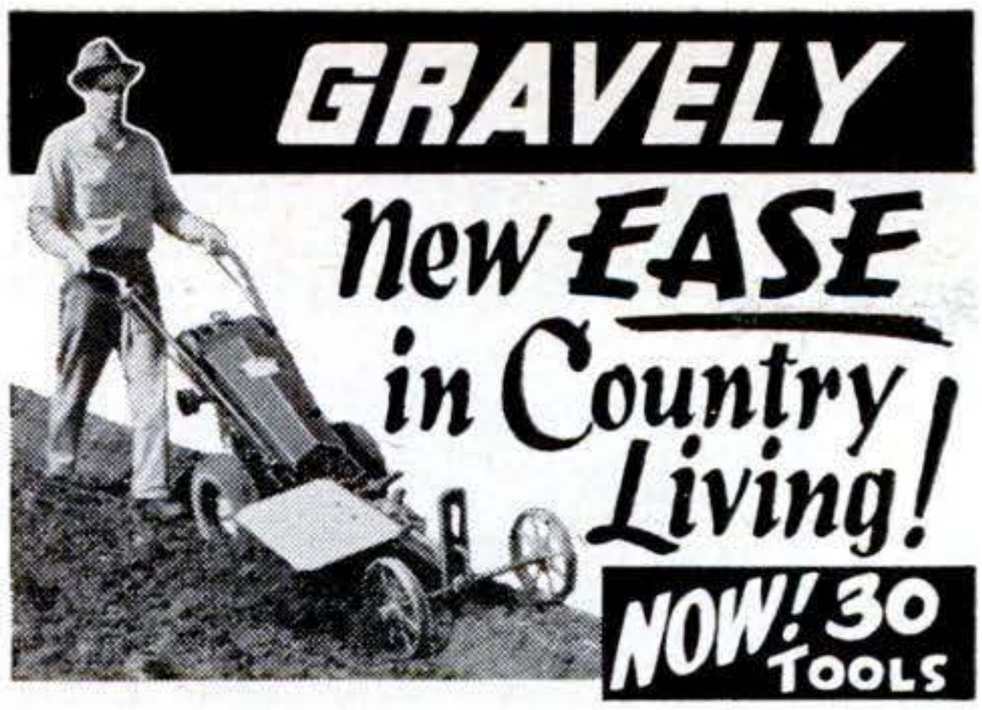

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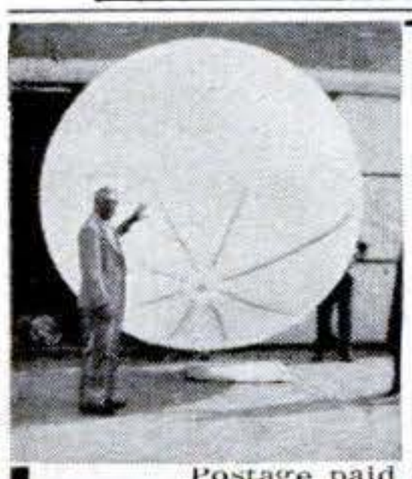

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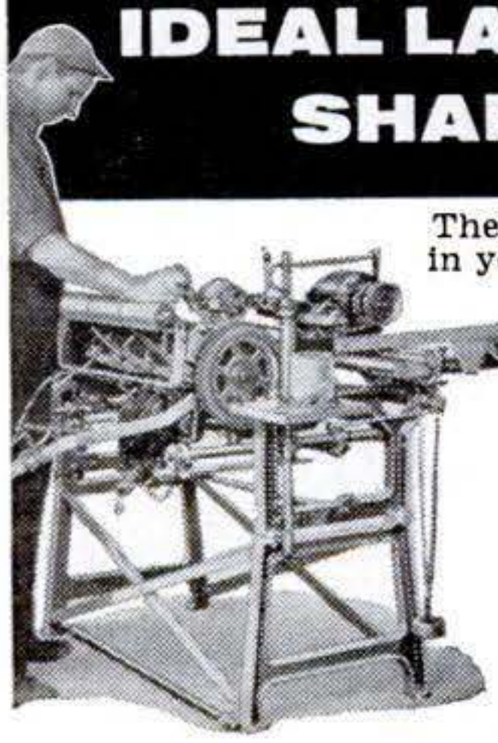

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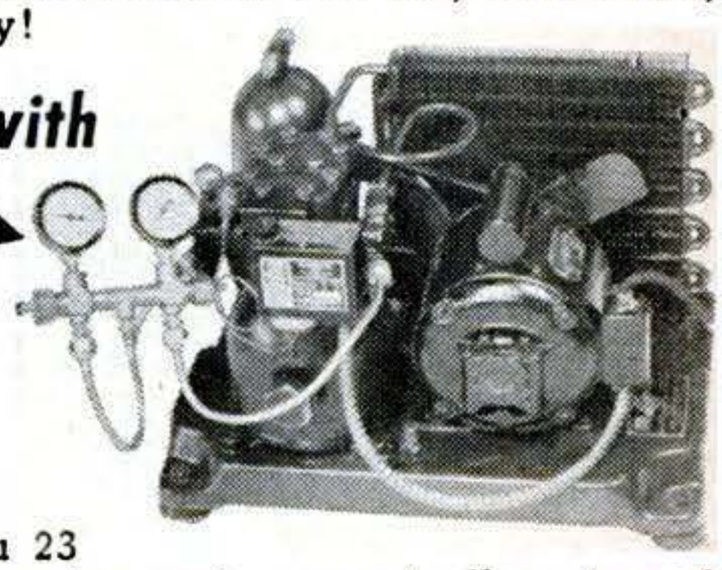

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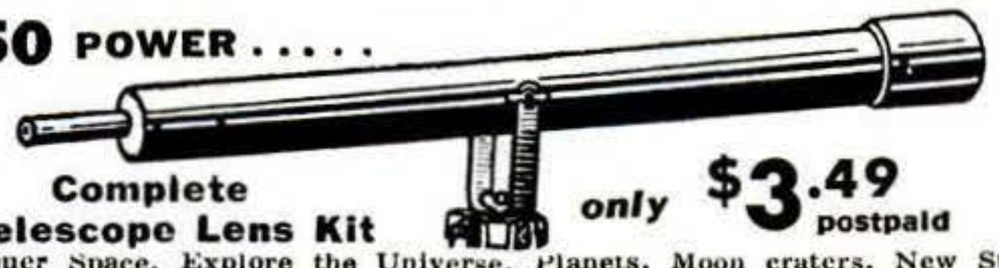

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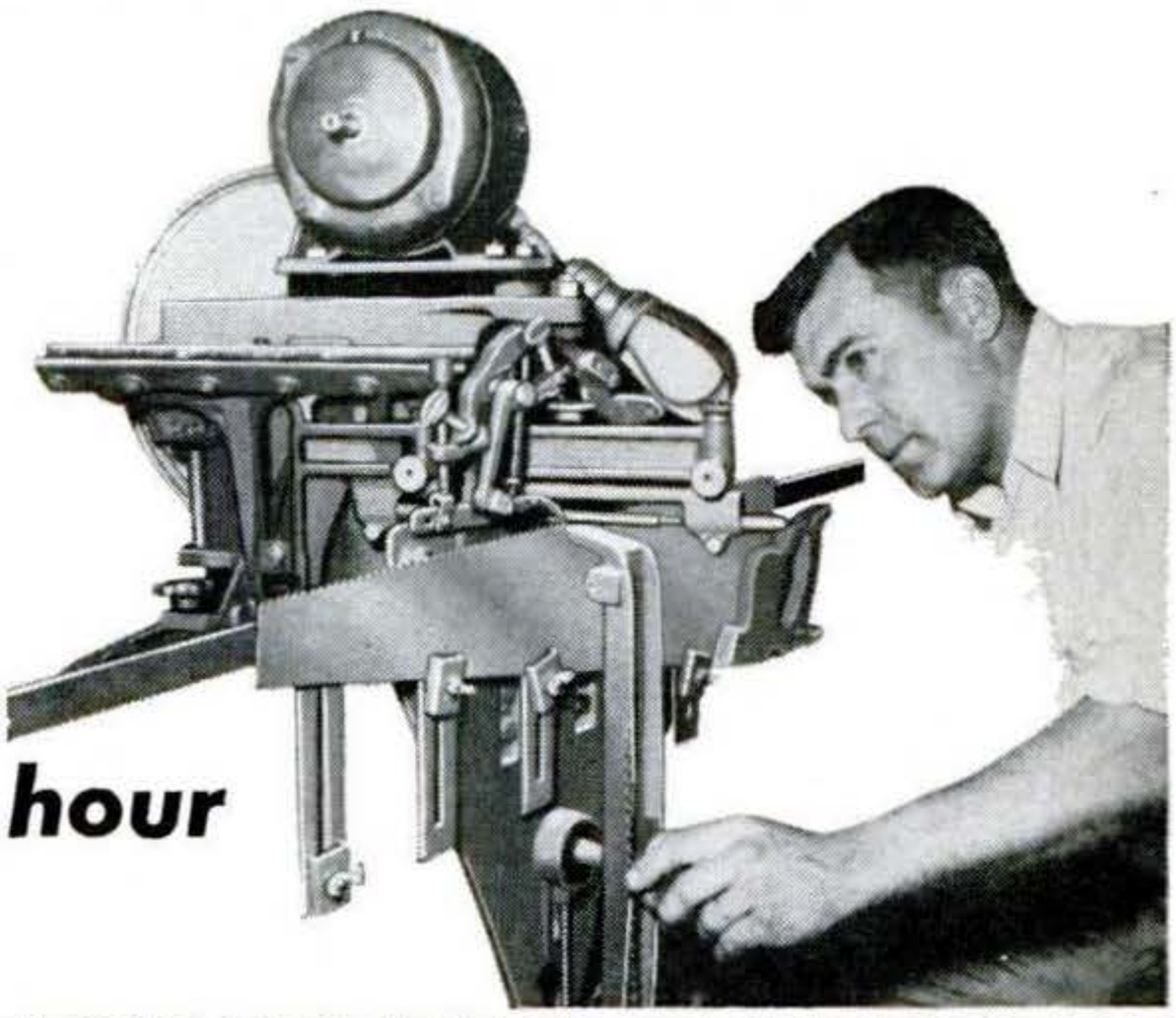

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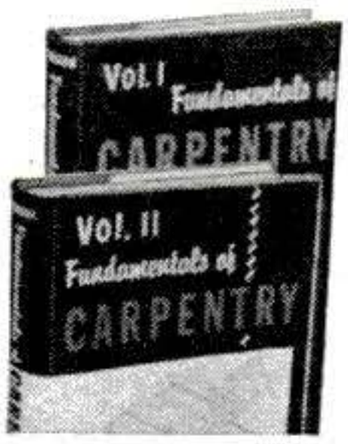

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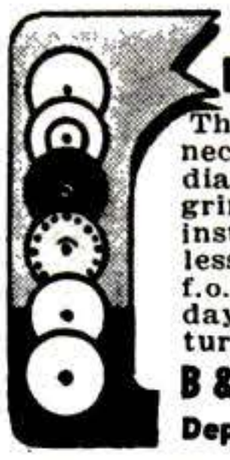

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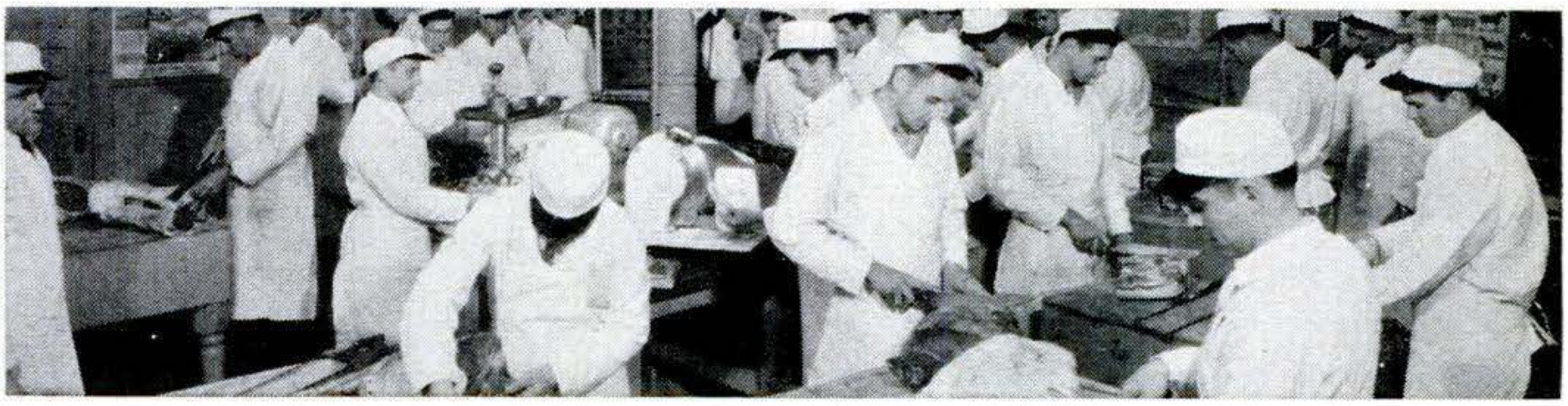

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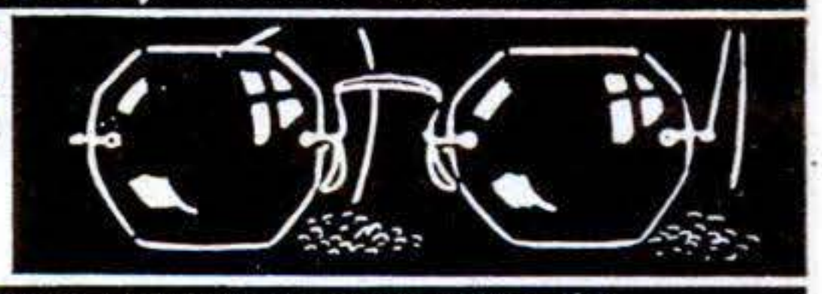

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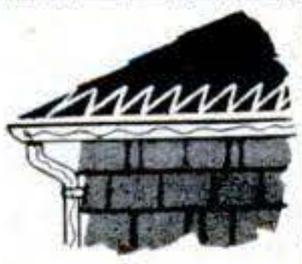

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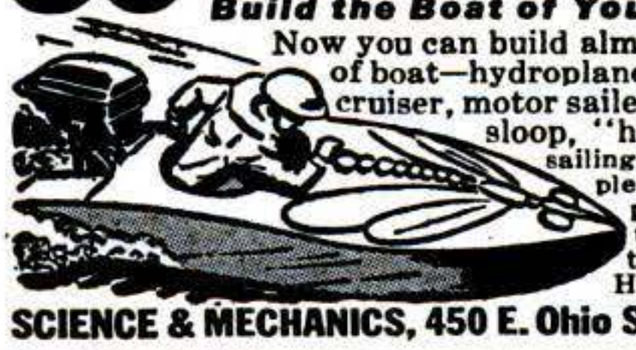

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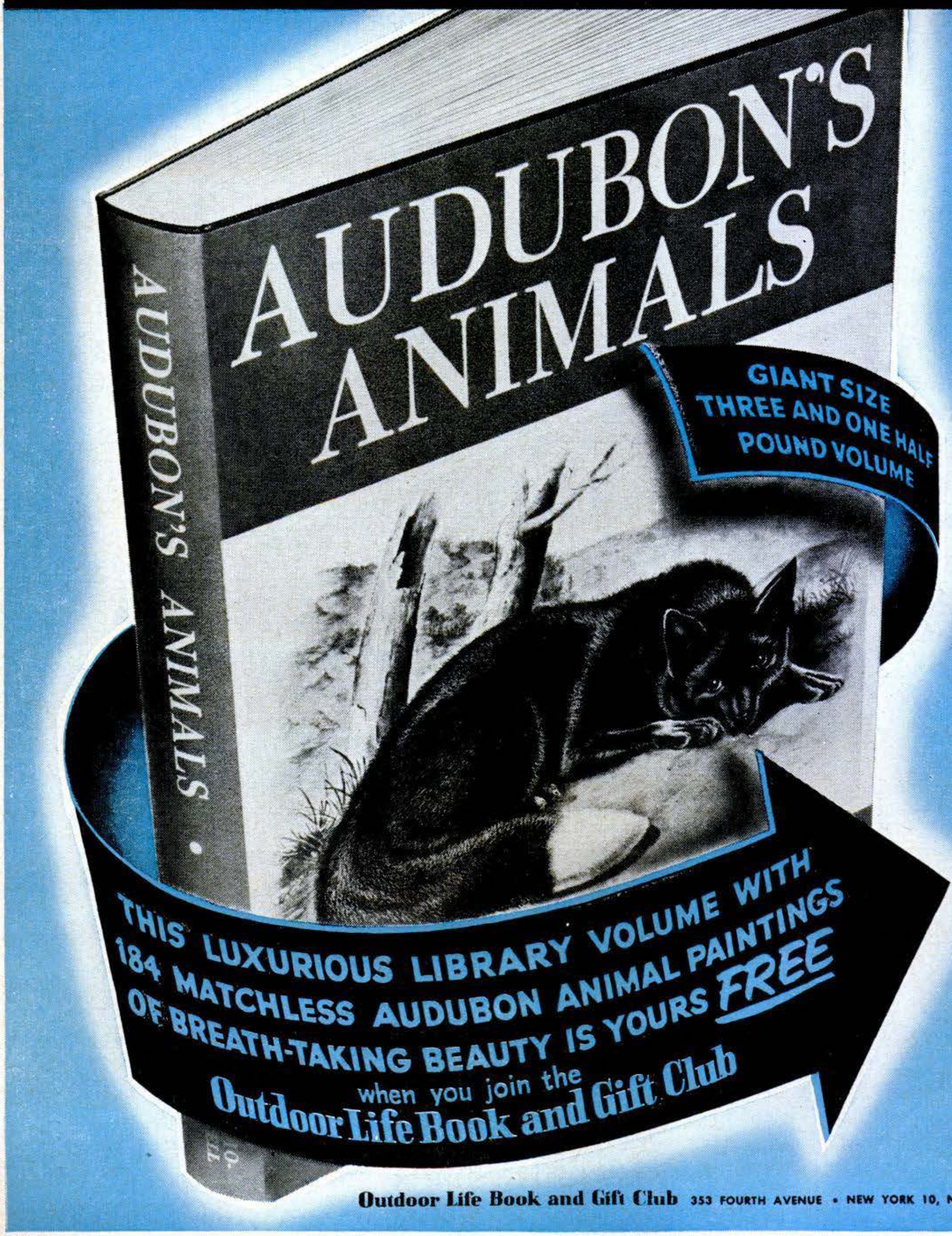

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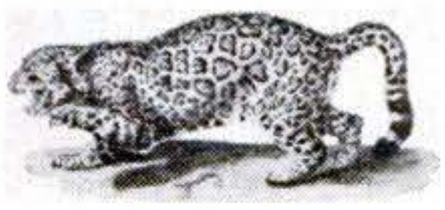

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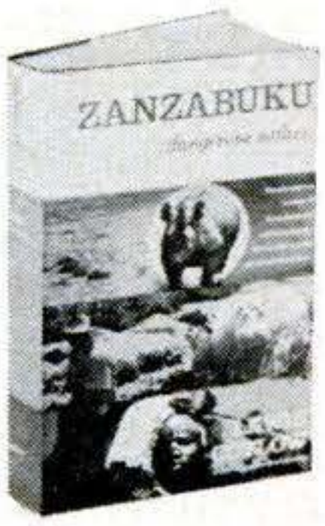

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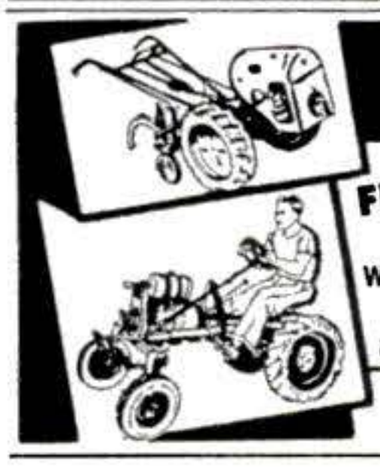

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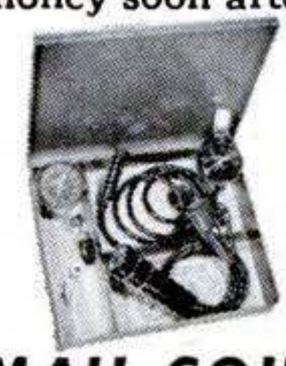

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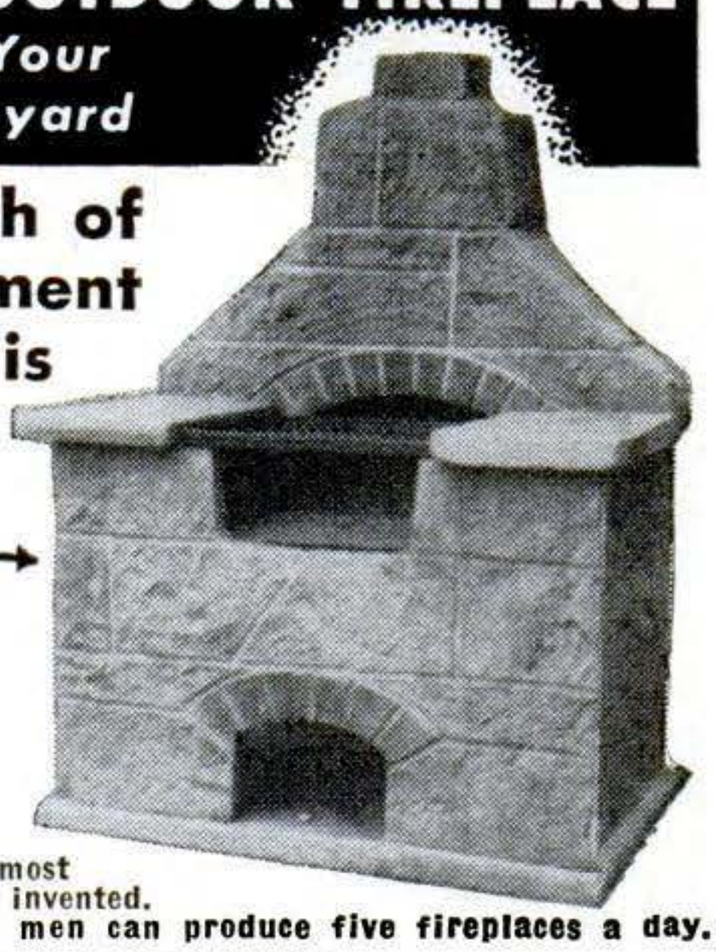

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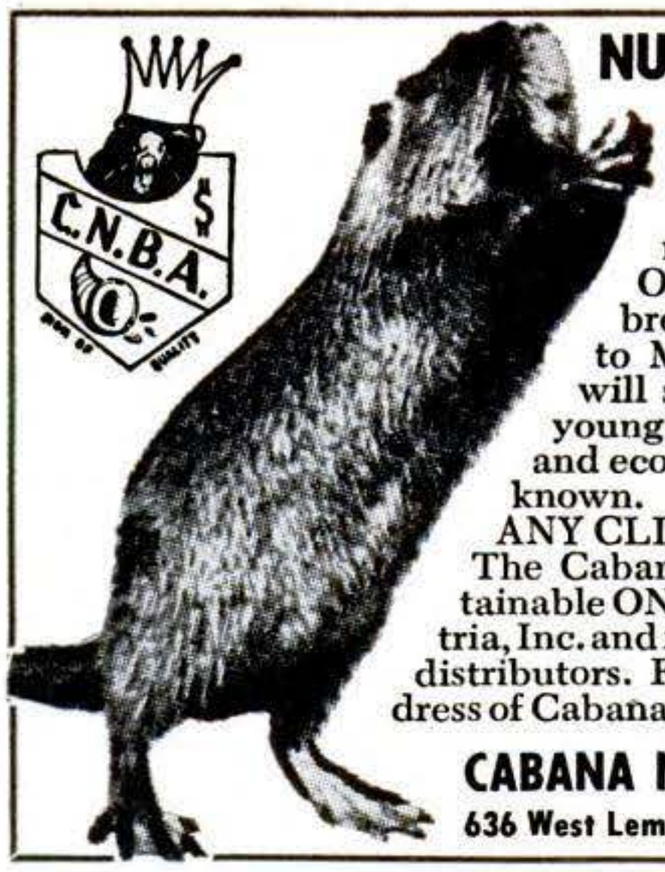

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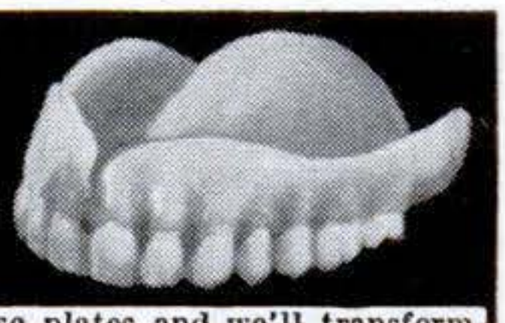

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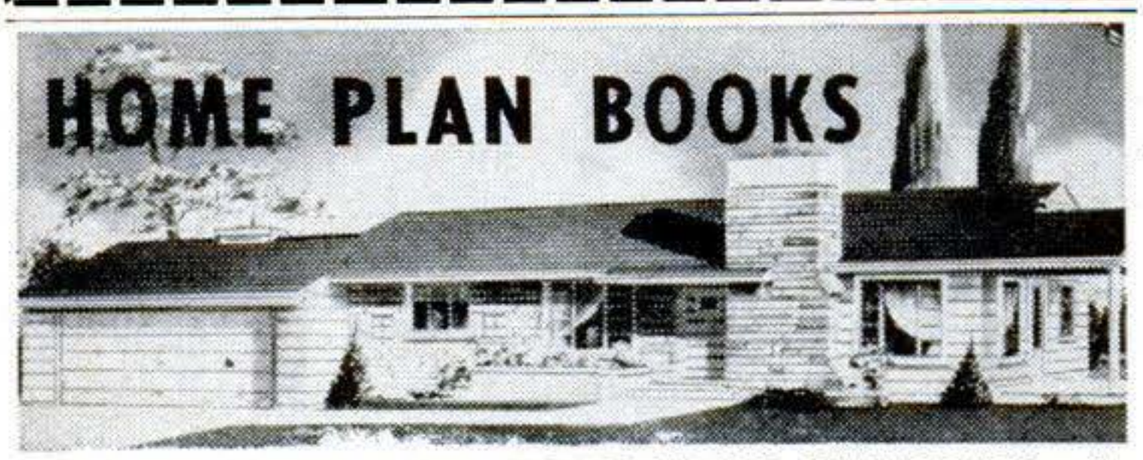

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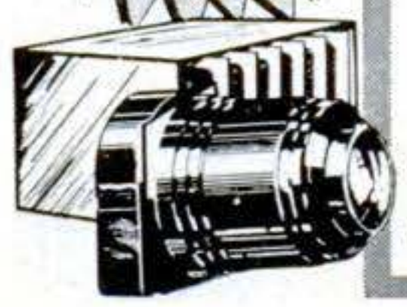

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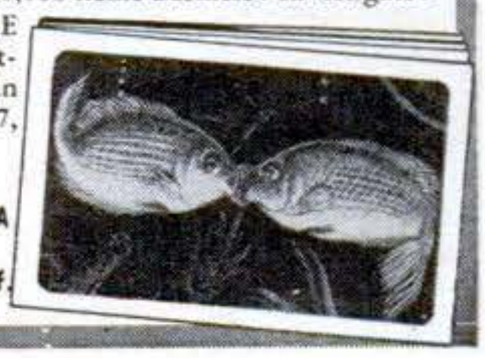

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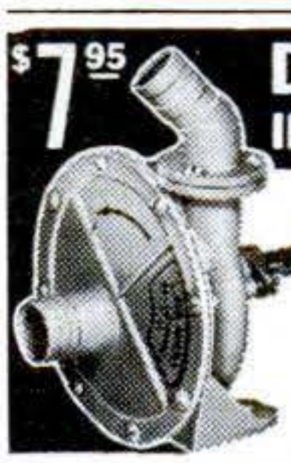

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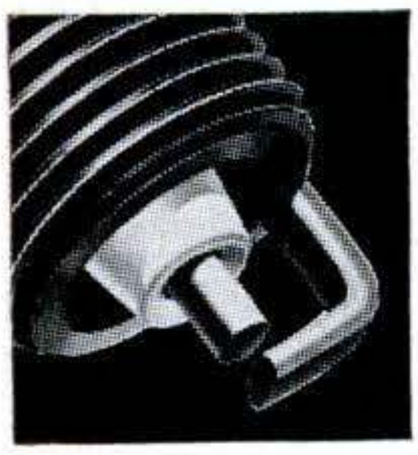

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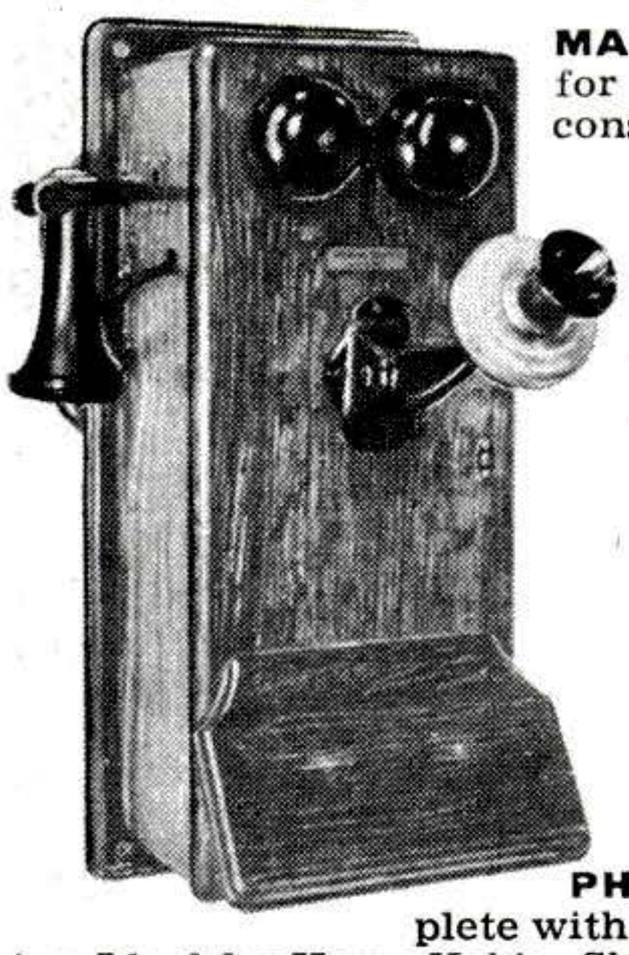

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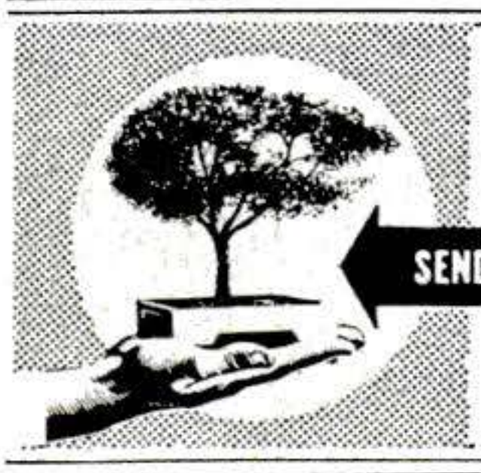

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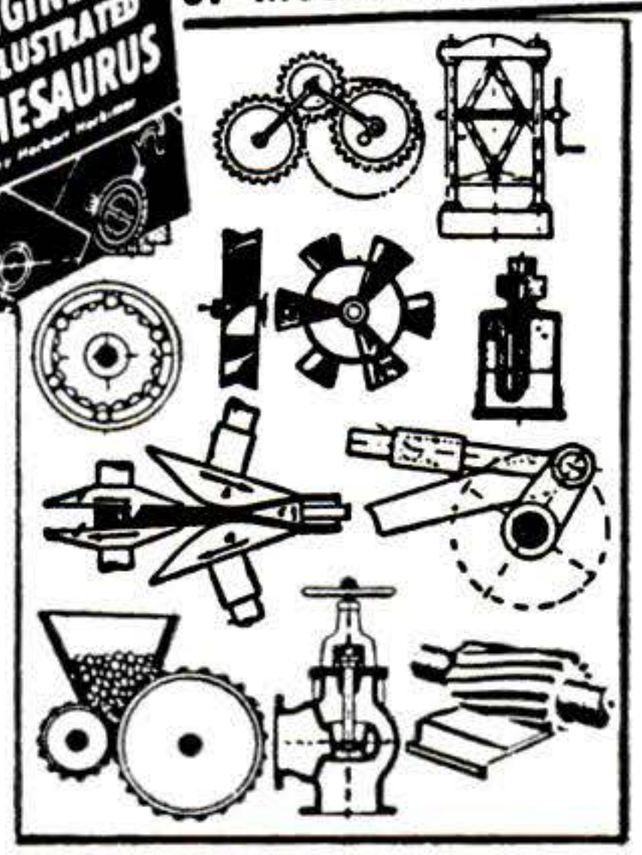

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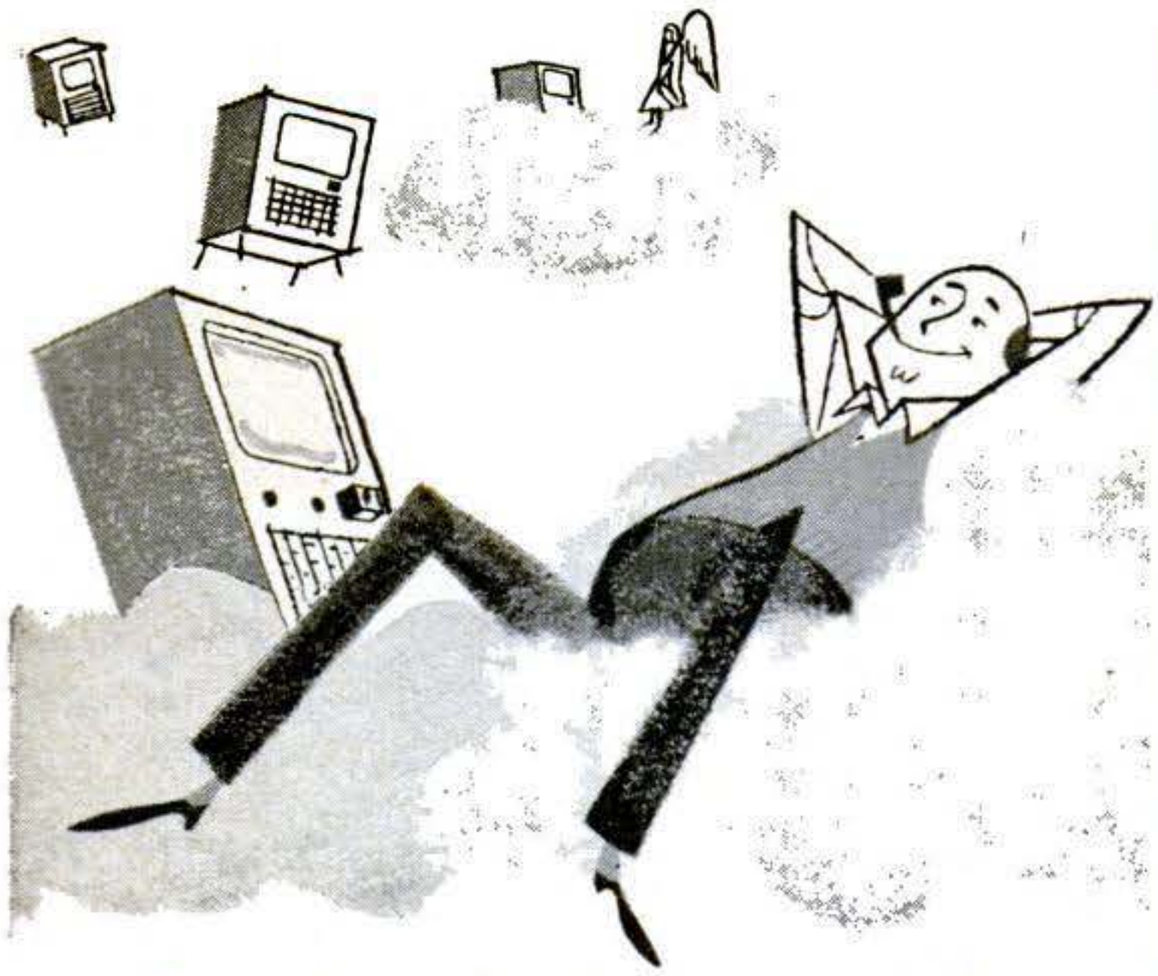

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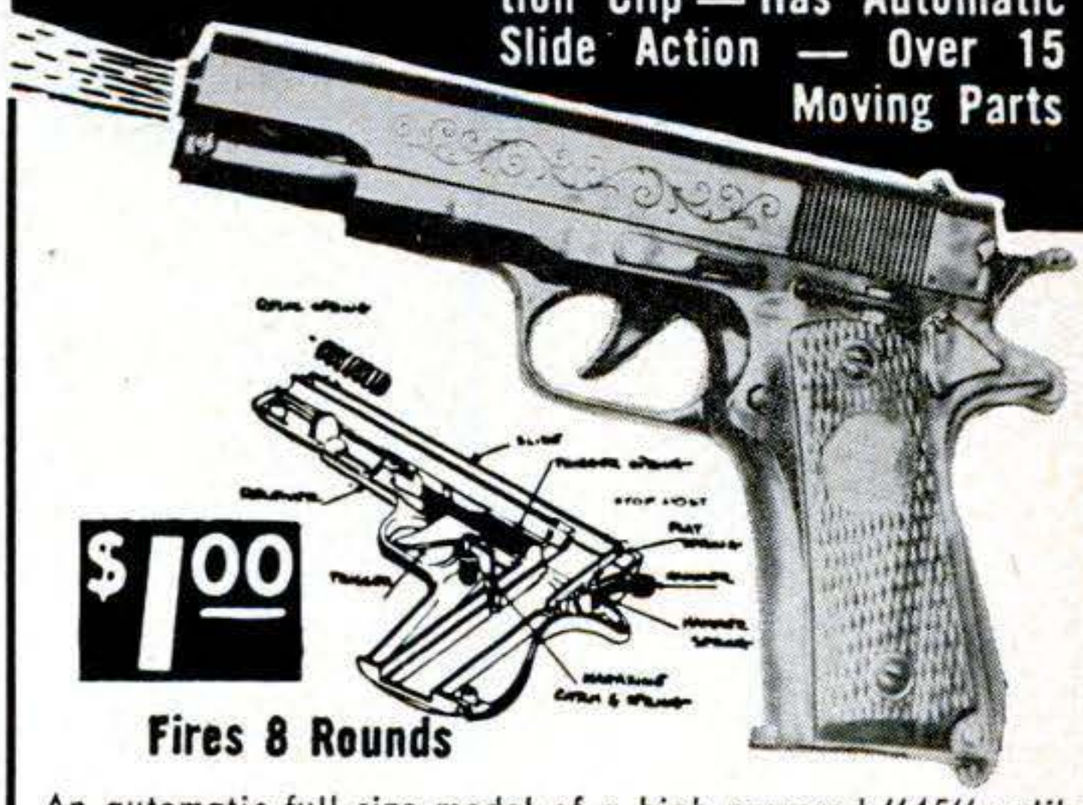

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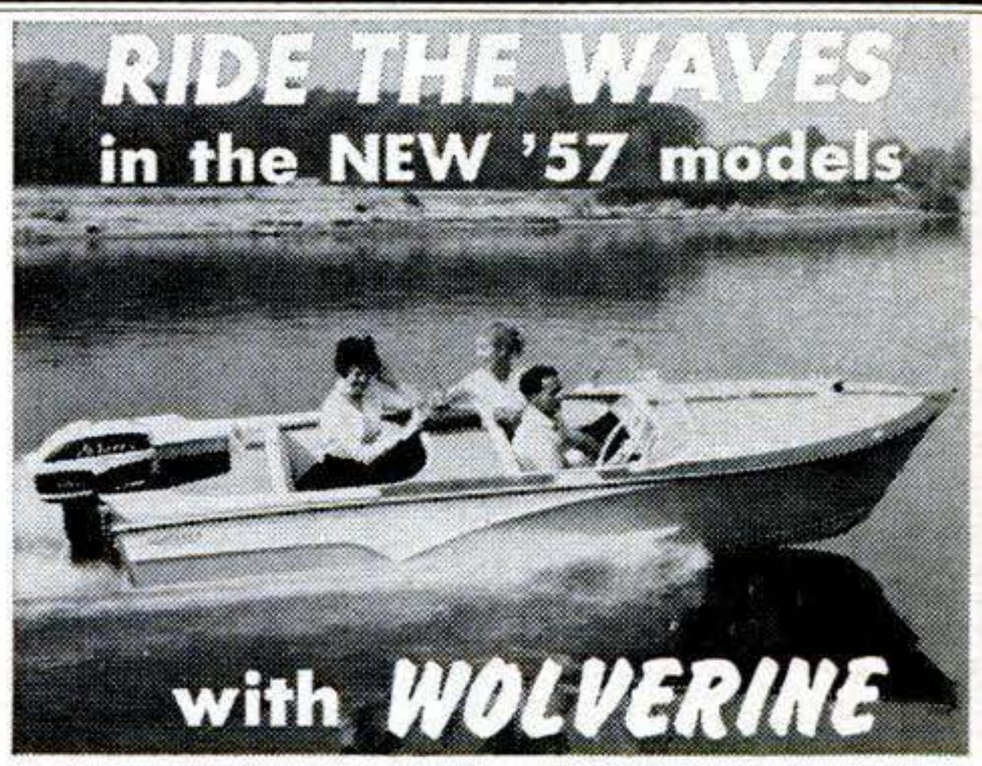

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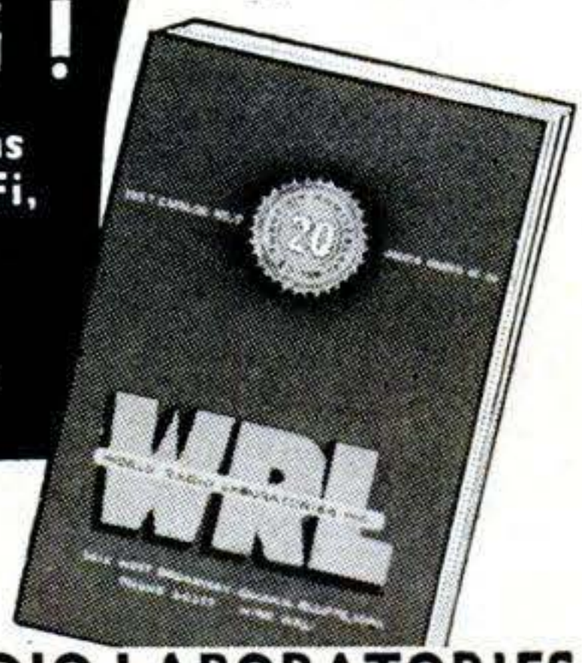

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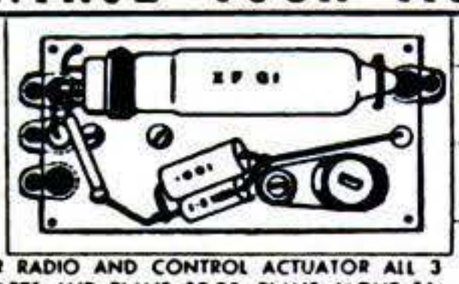

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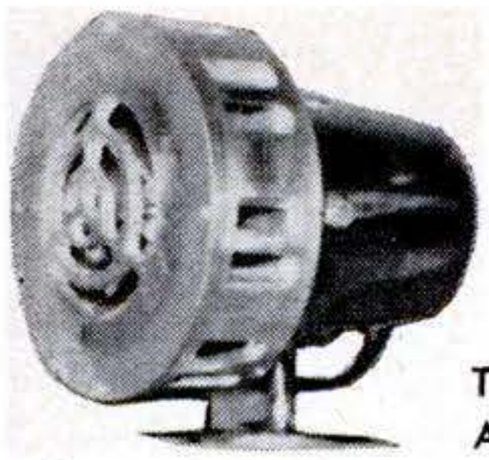

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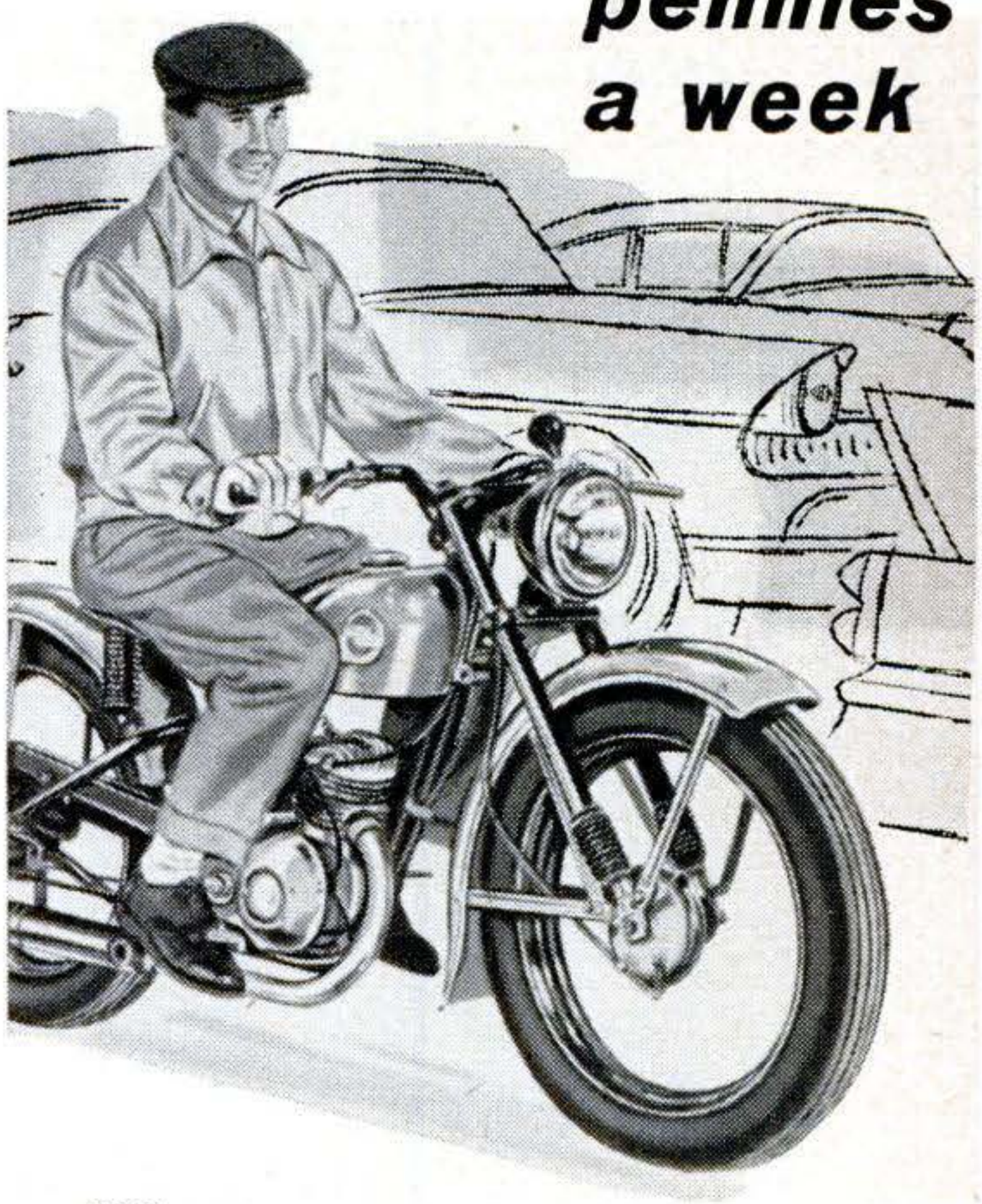

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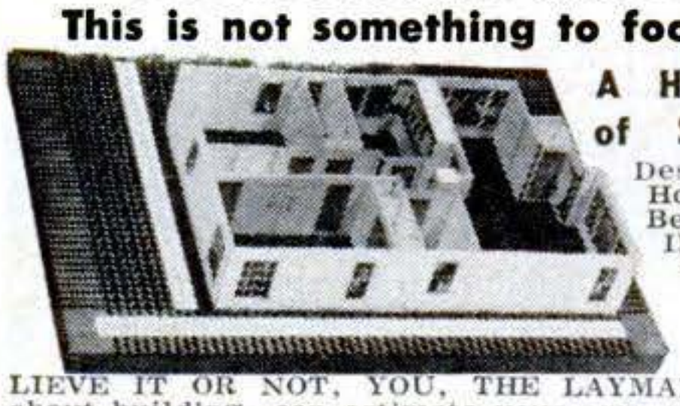

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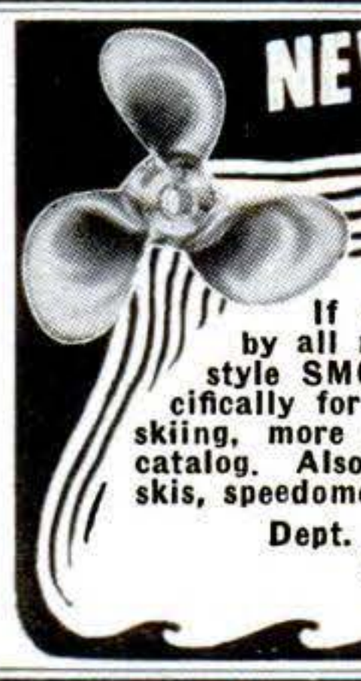

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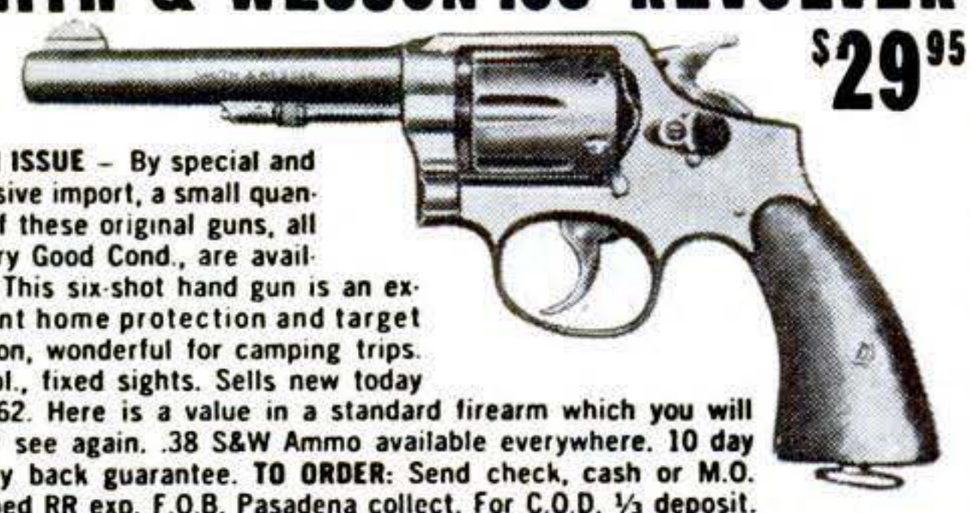

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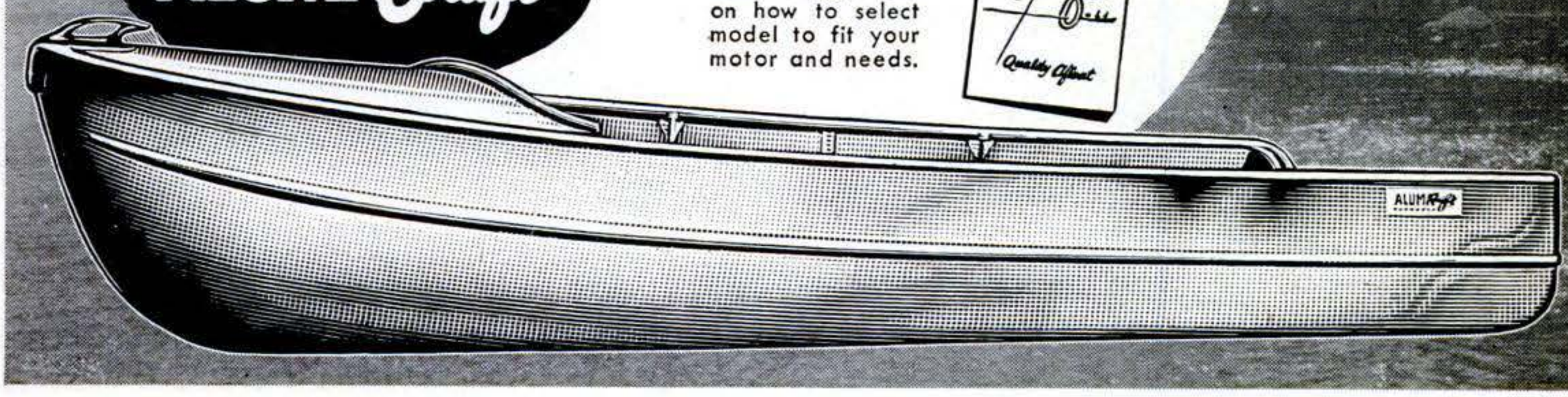

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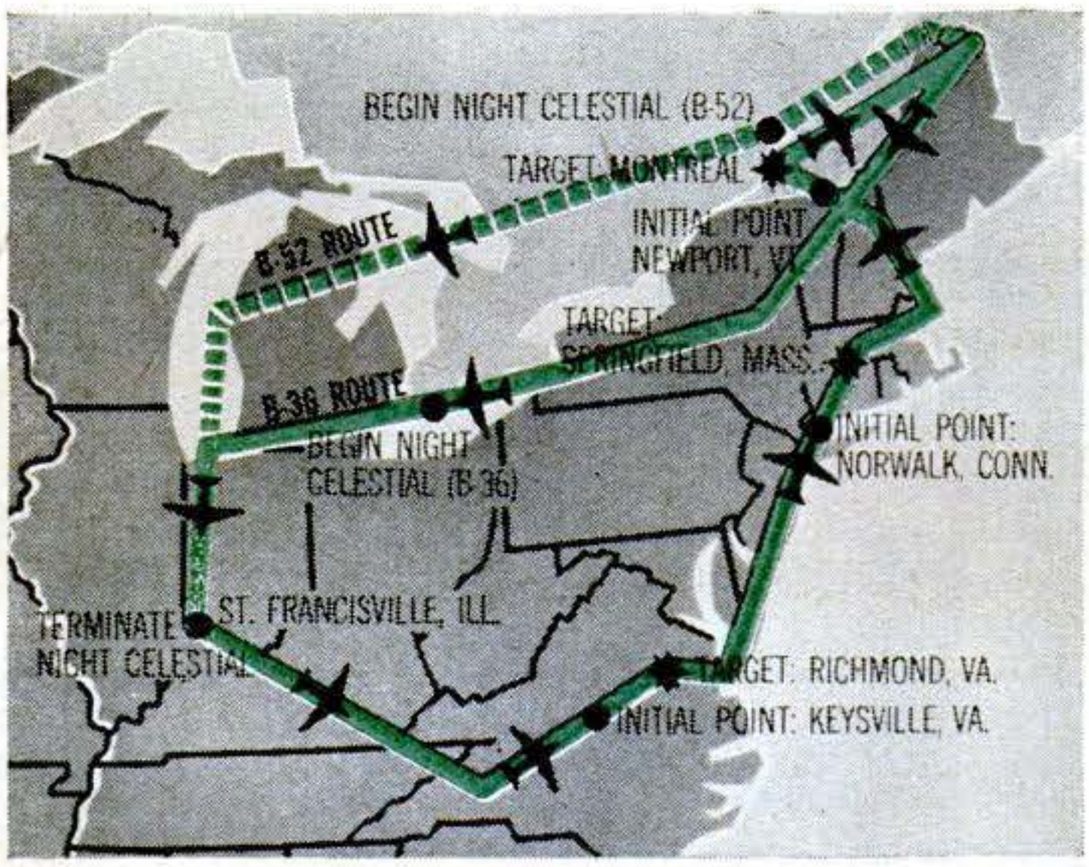
Here's where they separate the H-men from the boys: the "World Series for Bombers."

Let the crosswinds blow: The B-52 pilot simply steers his wheels down the centerline and

Night Radar Raid in

By Frank Harvey, with photographs by W. W. Morris

IT WAS one o'clock in the morning at Loring Air Force Base, in Maine, and Captain Linn Wright's B-52 was buttoned up for takeoff. In the glare of the floods, the 200-ton, $8,000,000 bomber loomed high as a house, long as a destroyer. Her sweptback wings drooped under tons of jet fuel inside—plus two enormous tip tanks. Her tail climbed four stories into the night. Her underbelly and jet



WORLD SERIES' ROUTE: Bombers must follow this 3,100-mile course—and "touch all bases."

SPOT PROMOTIONS await winners. Here Capt. Linn Wright reads weather flash to hopeful crew.

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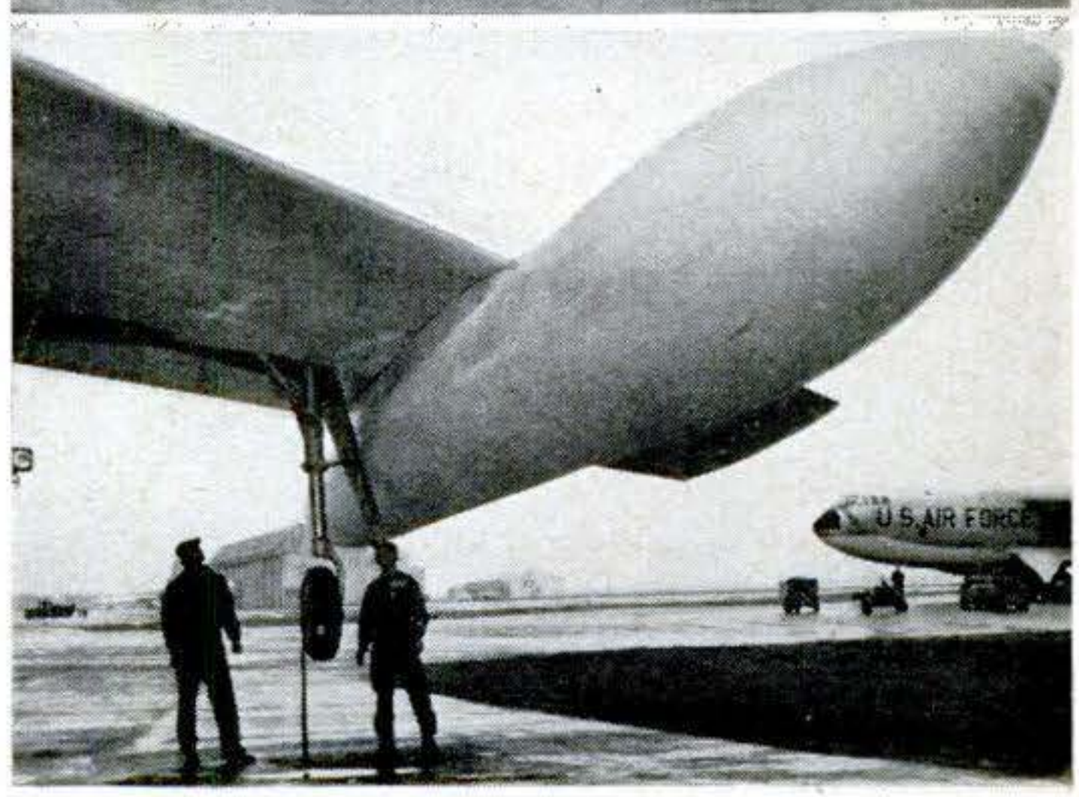
"crabs on down" the runway as above with wings and fuselage pointing in another direction.

Our Hydrogen Bomber

pods—which could hose out 25,000 pounds of thrust per pod—were painted white to reflect away the blinding flash and heat of her own H-bomb as she fled away from it above 50,000 feet at almost the speed of sound. Here stood the deadliest piece of transport in the world—a flying machine that could rise from Loring AFB, smash a city anywhere on earth and return nonstop!

Up in the red-lit cockpits, Linn Wright and his crew were tense as tight-strung wire. In a few minutes they would take off on their initial flight in the Strategic Air Command's annual "world series of bombing," which draws the most expert SAC crews from bases world-wide to compete against each other for top bombing and navigational honors—and a spot promotion for every man in the winning crew.

Originated by SAC's commander, Gen. Curtis LeMay, the "world series" is staged on a new course each year. Crews



BEFORE AND AFTER: B-52's wing sags heavily before takeoff under weight of its enormous drop tank. Upon landing hours later, with fuel exhausted, the wing rides high in the air.

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Peering through window of tanker, refueling operator steers boom into snout of a B-52

MINUTES AFTER CONTACT, B-52, tons heavier with a bellyful of JP-4 jet fuel, disconnects (right) from its hovering tanker. With in-flight refueling like this, B-52s can deliver a multi-megaton H-bomb from the U.S. anywhere in the world, and complete the trip home nonstop.

fly at night, make three radar-guided bomb runs over the course and one celestial-navigation run.

Scores are based on the best performance of three nights of bombing, and "drops" are scored by special radar trucks placed near the targets. When the bombardier "punches the pickle," he sends out a signal that gives the radar trucks an exact fix on where his "bomb" would have fallen.

This was the B-52's first time at bat in the big league. She was, in fact, still so new at Loring AFB that Capt. Wright and his men had not even had time to qualify as a "combat-ready" crew. They were old pros in the smaller B-47 jet bomber—but in the big B-52 they were still raw rookies.

The sky overhead was deep purple, dusted with stars and lit by a lopsided moon—but the Loring weather officer had advised of a far different situation waiting for them over toward Chicago, on the "night celestial leg" of the navigation course.

45,000-foot thunderheads towered there into the stratosphere, full of lightning, hail, rain and explosive air currents. Wright's B-52 would have to bore through some of these monsters—or risk screwing up navigation by trying to evade them. Tonight was no time for timid cloud-dodging. There were 43 other airplanes in the meet: B-36s, B-47s and B-52s. All were directed by the ace navigators of SAC, and every man at a chart was mentally pinning those new

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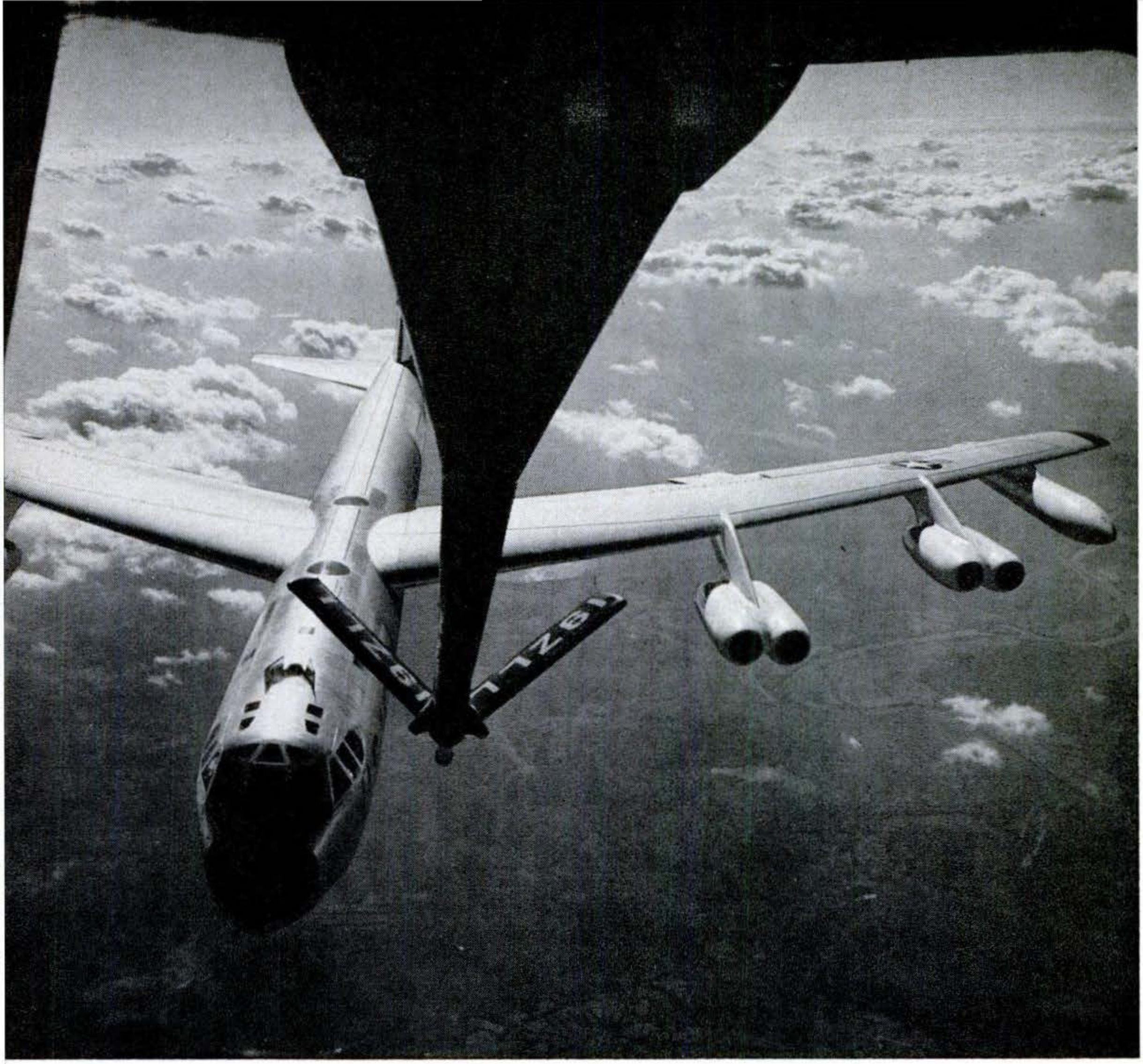

spot-promotion insignia on his duckbill cap right now.

The bigger B-36s obviously had the edge. They'd flown this world series many times before and knew the routine by heart. They had 15 men in the crew—as against six in the B-52—and flew only half as fast, giving them many more minutes of precious time to work out navigational problems.

The B-52 tore through space at 650 miles an hour. If its navigator missed his Estimated Time of Arrival by a mere 60 seconds, his airplane would be ramrodding almost 11 miles off into the boondocks. If he let his pencil grow dull while lining in a star fix, the width of the lead could throw him half a mile off the target. Half a mile is usually nothing at all at the end of a nav run—but in this red-hot league it could mean the ball game.

Capt. Ambrose Maushart, Wright's navigator, would aim his B-52 at a pinpoint in the sky over a certain water tower in St. Francisville, Ill. Using only the stars to guide him, Maushart would direct the airplane until he judged it to be precisely over the target. Then he would key a signal to the radar truck on the ground at St. Francisville, and would be scored with fantastic accuracy. They could tell—within a foot—how far he'd missed dropping his "bomb" on the center of the water tower.

Coming back east again, Capt. Bob Townley, the observer, would try to "shack" the three H-bomb targets: Rich-

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DEADLY TAIL TURRET mounts four guns that seek out an attacking fighter with radar eyes, track and "lock" on him automatically. He is caught in a deadly spray of 50-caliber bullets.

mond, Va.; Springfield, Mass.; and Montreal, Canada.

"Shacking the target" is an old Air Force term going back to the days when there was a wooden shack in the center of ground targets, suitable for storing cold beer and sacking out in rainstorms. Naturally, old-time bombardiers tried earnestly to puncture the roof with a steel egg, and when they did the drop was known as a "shack." In 1956 the term was still going strong, but much harder to come by with a plane flying at 50,000 feet in the air, at night, and at close to the speed of sound. For example, there'd been only one shack job out of thousands of tries at SAC's 1954 world series, at Barksdale, La.

The B-52 crew was hopeful, however. They had a new bombsight that gobbled up a steady stream of altitudes, speeds, temperatures and winds—scrambled them around in its electronic brain—and spat out an aiming point. But the approach was a thing of vital importance.

A hundred miles away from the target, Townley would begin going over a long list of operations that had to be completed before the B-52 was ready to release its hydrogen egg. Maushart, sitting beside him, double-checked every item. Fifty miles out, at the Initial Point—IP in bomber lingo—the plane was ready. Townley would then take over, open the bomb-bay doors, "kill the cross wind," and grasp the tracking handle for the final payoff. The handle is a rubber-clad stub with a button on top. If Townley pressed that button in war he could conceivably wipe out a city in a single heartbeat, making him and other SAC observers the deadliest human beings alive today.

Townley, an Alabama boy with a ready grin and a broken nose from his football days, didn't look very deadly. And like any good rebel, he was a little reluctant about bombing good old Richmond, Virginia. He muttered that he felt like skipping Richmond and saving his best efforts for the Yankee stronghold of Springfield, Mass.—but rival B-36 crews advised him not to worry. He wouldn't hit the Richmond target (a Naval Training School); he probably wouldn't even hit Richmond; and, as a matter of fact, he'd be lucky if he got his radar "bomb" inside the state of Virginia.

"If I were flying that king-sized helicopter you guys call a B-36," Townley retorted, with his best rebel grin, "I wouldn't even bother to turn on the bombsight. I'd just count one, two, three—kick out the bomb with my left foot—and shack the target every time."

NEXT MONTH . . .
The M-61 is ready . . . just in case. PS made a special trip to West Germany for this report on the Air Force's atom-armed guided missile.

During the afternoon, Capt. Wright had given me the dollar-special cockpit checkout in his B-52, and said he certainly didn't expect any shacks. He'd be happy if all his bombs weren't "boondockers." But he was very informative (within strict security limits) about his big airplane.

It flies much higher than the standby jet interceptors now in mass field use: Sabres, Starfires and Scorpions. Should any of these planes stagger up to approximately the same altitude, the B-52 merely pulls a steep bank. If the fighter tries to follow, its stubby wings lose their grip on the thin air, and it spins help-

[*Continued on page 258*]

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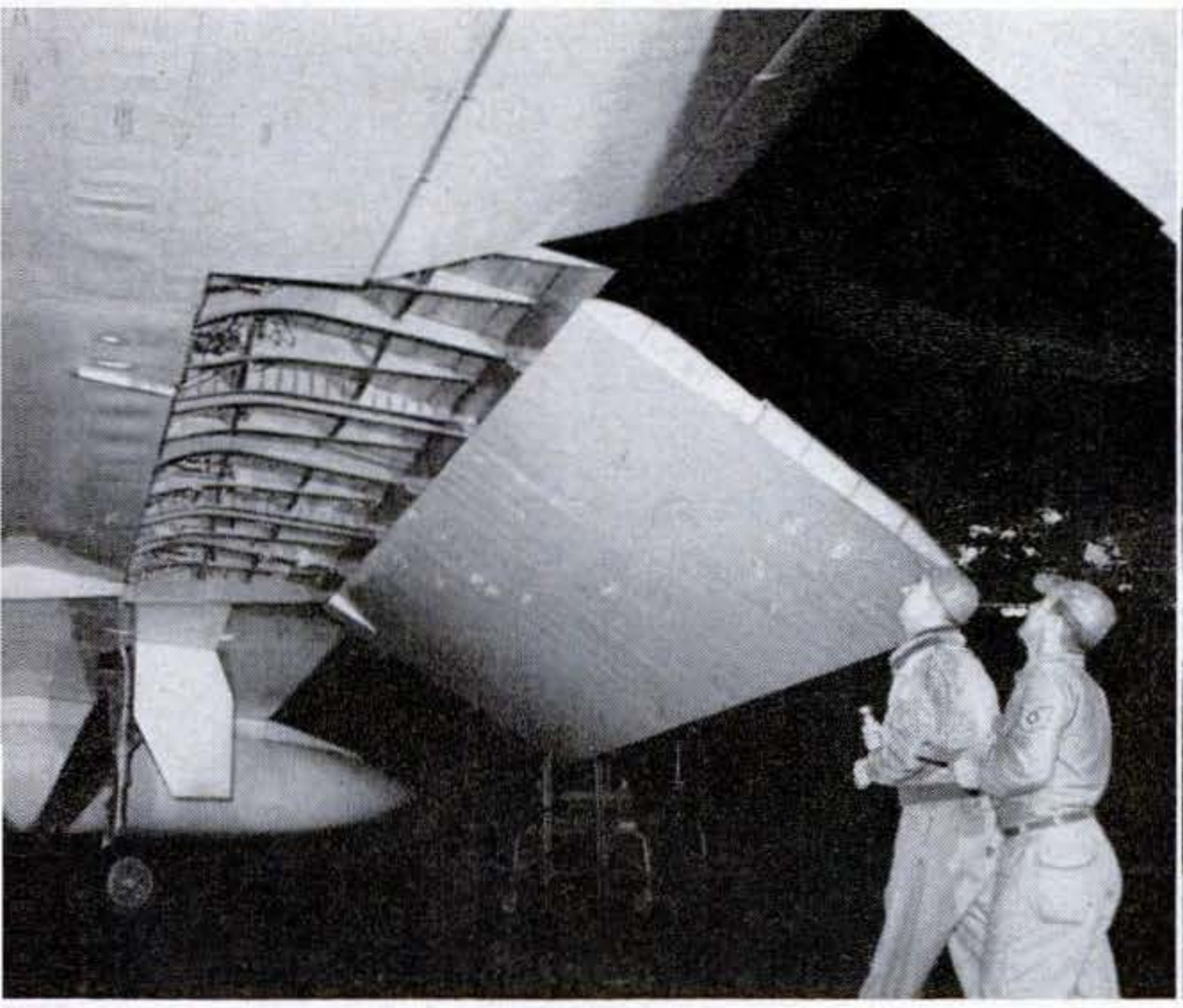
LOOK—NO PROPS! But these seemingly empty jet tubes sound off like 1,500,000 people talking all at once, and power the 200-ton B-52 to targets at almost the speed of sound.



PRE-MISSION CHECKUP is old habit with Capt. Wright and crew chief. Huge wing flaps slow bomber on final approach. Stubby aileron above men's heads is for high-speed cruise control.

BOMBER'S FOOTWORK requires eight of these wheels. For crosswind landings, they swivel at the touch of a fingertip. To help streamlined flight, they suck up into the plane's belly.

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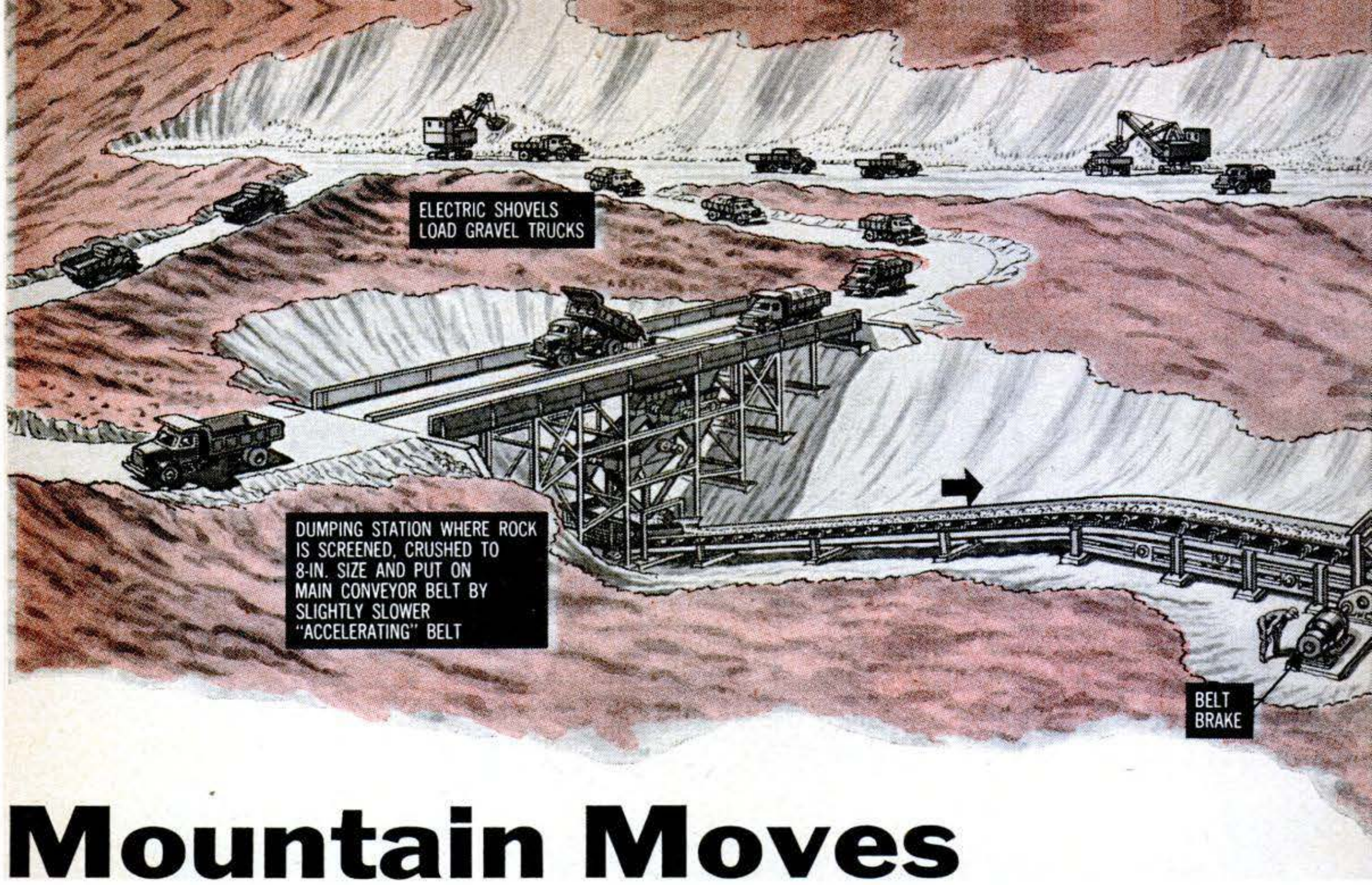


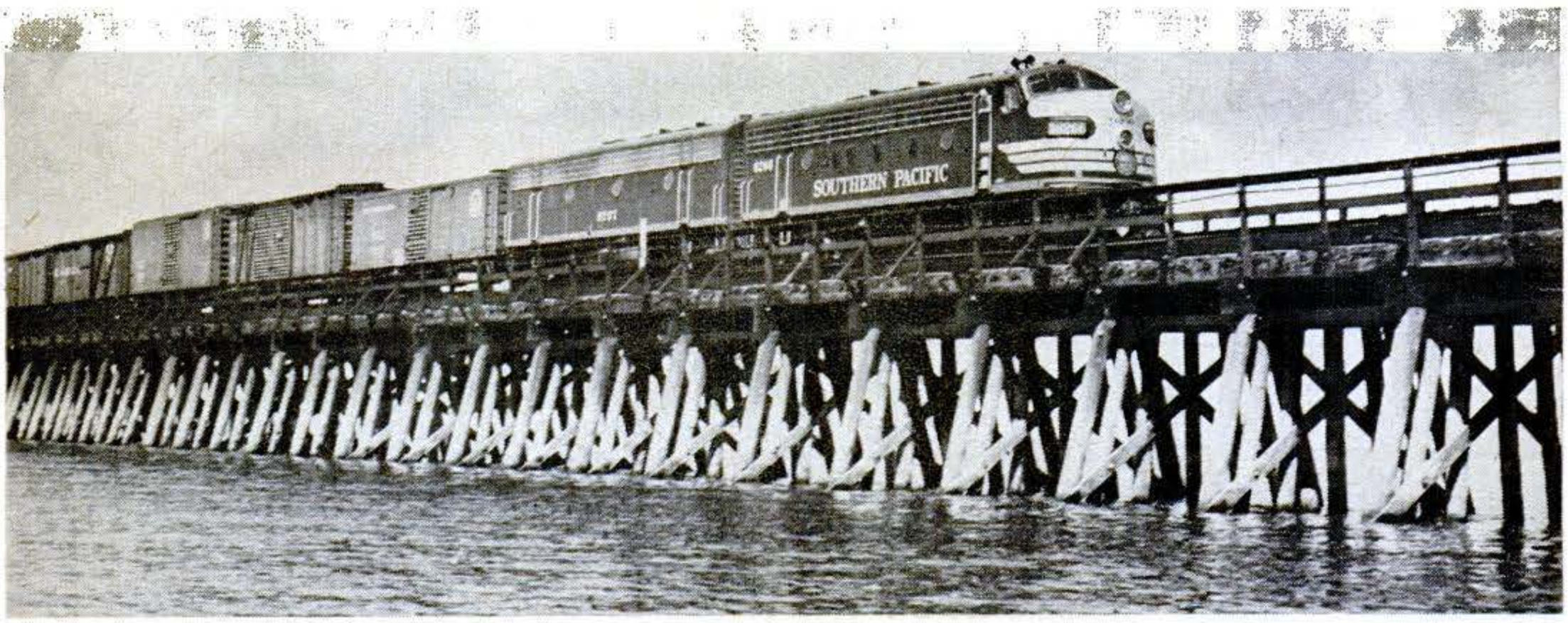
Mountain Moves Itself Two Miles

Engineers trick gravity into running a giant conveyor belt —to build a 13-mile gravel bridge across Great Salt Lake.

FORTY miles northwest of Salt Lake City, Utah, a gravity-powered conveyor belt is setting new construction records on Southern Pacific's biggest engineering project since the building of the first transcontinental railroad.

This high-speed conveyor system is dumping a 30-million-ton mountain of gravel in Great Salt Lake for construction of a new causeway that will replace a 13-mile-long wooden trestle over the water. In three years, streamliners will be speeding across the 30-mile expanse of inland sea on a solid-earth roadbed.

Although construction men are ac-



THIS IS THE WOODEN TRESTLE, 52 years old, that will be replaced by a 13-mile-long permanent gravel roadbed now under construction for the Southern Pacific across Great Salt Lake.

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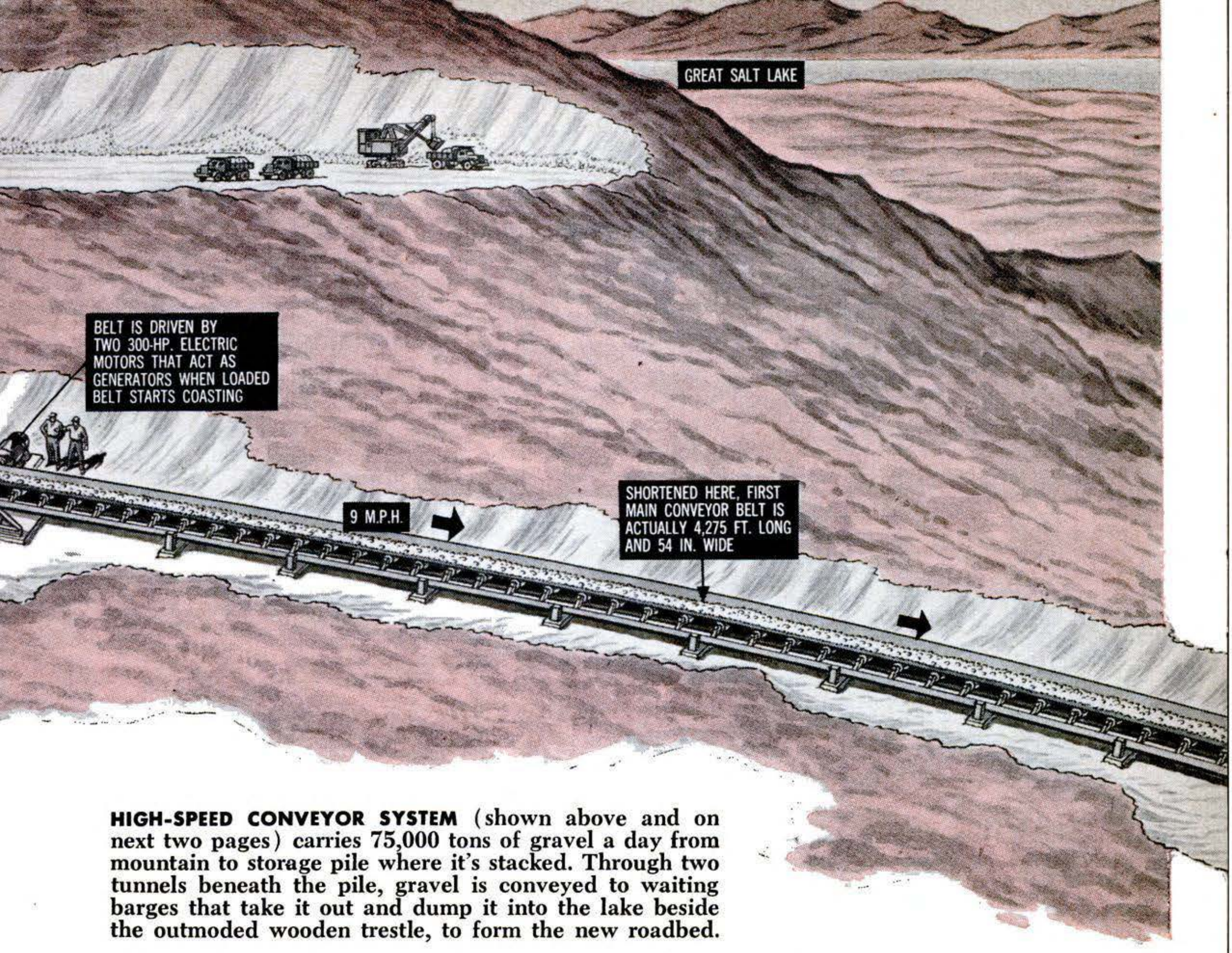

HIGH-SPEED CONVEYOR SYSTEM (shown above and on next two pages) carries 75,000 tons of gravel a day from mountain to storage pile where it's stacked. Through two tunnels beneath the pile, gravel is conveyed to waiting barges that take it out and dump it into the lake beside the outmoded wooden trestle, to form the new roadbed.

customed to transporting mountains of dirt during the course of big construction jobs, no earth-moving project has ever been accomplished with greater day-by-day speed or by a more ingenious earth-handling arrangement—a giant conveyor system that produces electricity instead of using it.

Because the project involved no ordinary earth-moving chore, engineers decided right from the start that no ordinary method for moving earth could fill the bill. As a result, a special high-speed, two-mile-long conveyor system was designed and built. Operating at its normal speed of 800 feet per minute (almost twice as fast as most conveyors), the system can handle a record-breaking 75,000 tons of gravel a day. All out, it can deliver 90,000 tons daily.

Speed and capacity, however, take second place when it comes to the engineering ingenuity that went into the big conveyor's design. As with any overland conveyor, the Utah system is equipped with electric drive motors. Once the motors have overcome the starting friction of the system, however, the conveyor belt continues to roll along on its own. The motors then become generators, producing usable electric power, besides serving as brakes to control the belt's speed. The power supplements other current, to drive three giant shovels that dig the gravel out of the hillside.

This "bootstrap" trick, which is about as close to perpetual motion as you can get, is made possible by the fact that the conveyor system runs downhill to the shore of the Great Salt Lake. The conveyors, once started, move under the force of gravity exerted on the continuous load of gravel they carry. And the electricity they produce is no small item. According to an estimate made by the engineers of Hewitt-Robins, Inc., who designed and built the entire gravel-handling system, the electricity manu-

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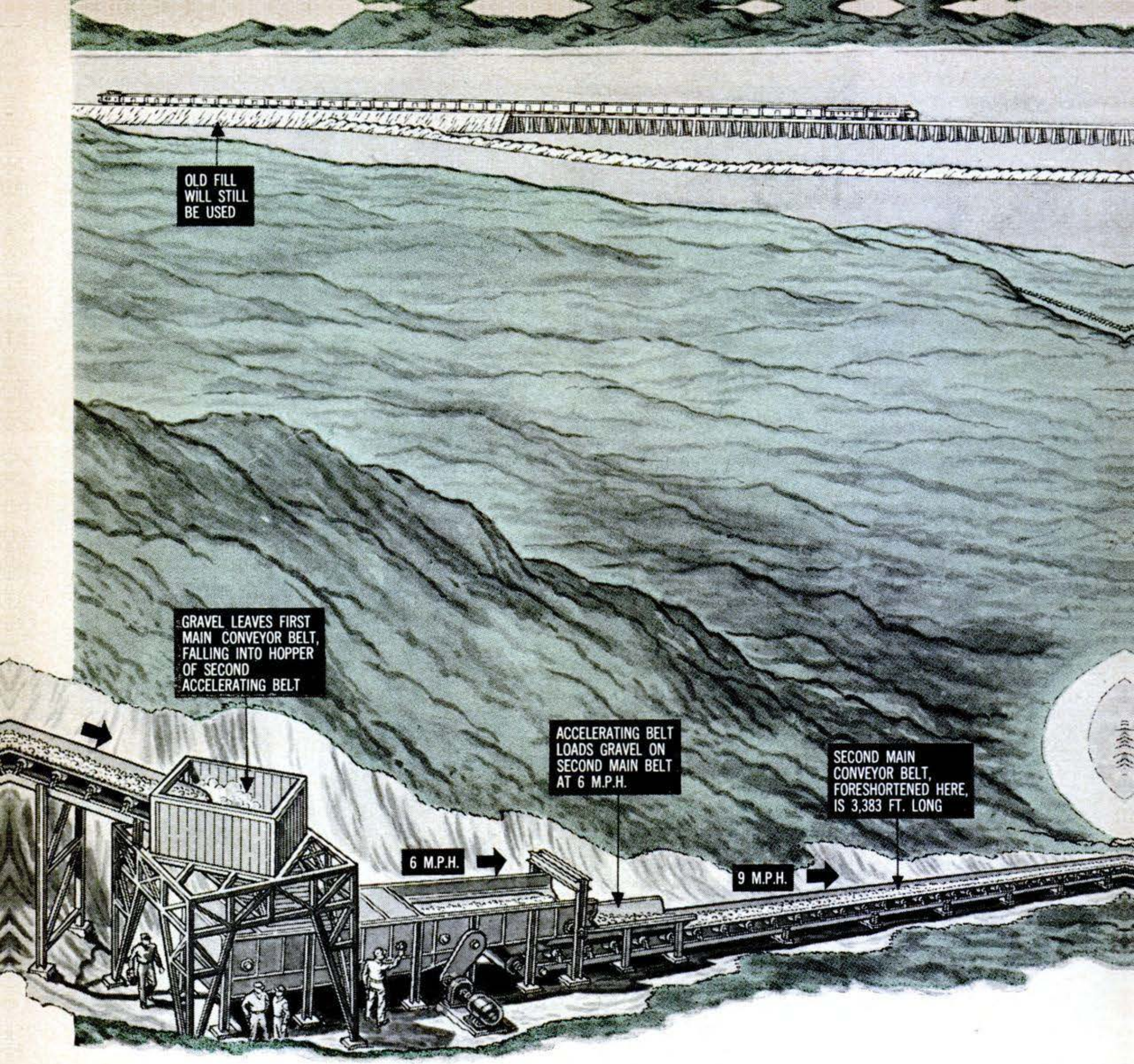

factured by the conveyors on their downward gravitational glide would be enough to take care of the power needs of some 4,000 average homes.

To reduce wear and tear caused by dropping 75,000 tons of sharp-pointed gravel on a long conveyor belt every day, the gravel is first hoppered onto a short accelerating belt. Running at a speed slightly under the speed of the long main conveyor belt, the short accelerating belt gives the gravel enough forward momentum to make a smooth transfer from one belt to the other with a minimum of impact or abrasion. When it wears, the short accelerating belt can be replaced easily and relatively inexpensively. At the juncture between the two main belts that make up the system, a second accelerating belt is used.

At the end of its two-mile downhill ride on the conveyors, the gravel is dumped onto a storage pile by a conveyor-fed radial stacker. On the average, the storage pile towers 70 feet in the air and contains enough gravel to take care of two days of causeway building. Conveyors under the big stack carry the gravel, as it is needed, to six giant bottom-drop barges and seven smaller deck-type barges that tie up to a loading pier on the lakeshore just 250 feet from the storage pile.

The barges shuttle back and forth between the causeway, nudging its way out into the lake, and the gravel-storage

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OLD TRESTLE TO BE ABANDONED

GRAVEL BARGES ARE DUMPED TO MAKE THE 13-MILE-LONG NEW FILL

DREDGE MAKING CUT 30 FT. DEEP IN LAKE BOTTOM FOR NEW FILL

RADIAL STACKER

TUNNEL

BARGE LOADING WITH GRAVEL

BARGE-LOADER DRIVE

DRIVE FOR SECOND MAIN BELT

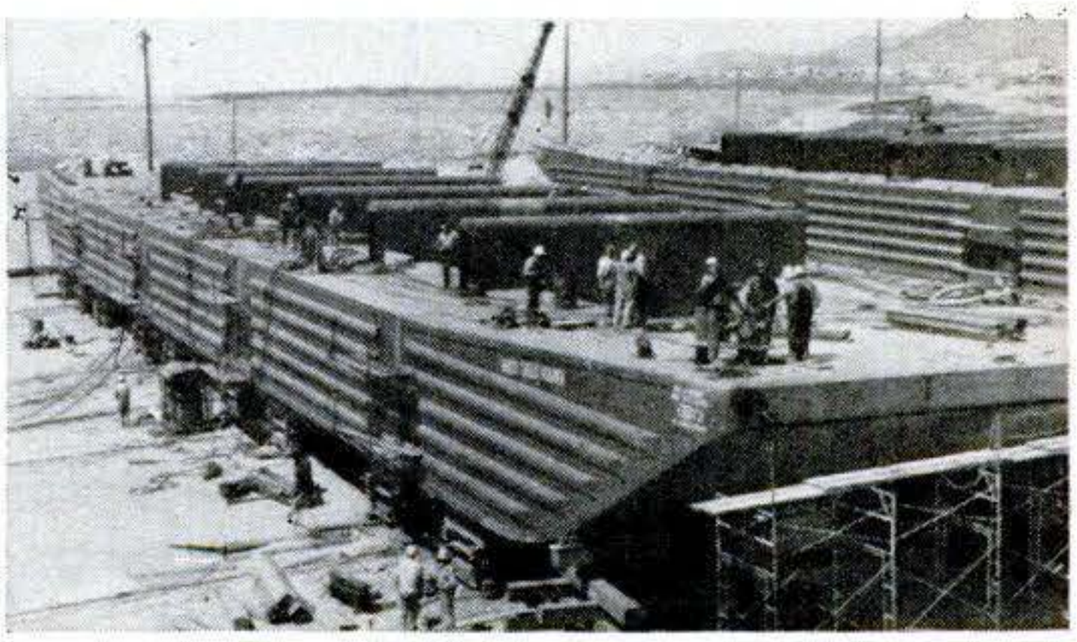
TUNNEL OF BARGE-LOADING CONVEYOR

GRAVEL PILE MADE BY RADIAL STACKER

area. The loading conveyors can fill the barges at a rate of 12,000 tons an hour.

The long causeway is being built out from the eastern shore of the lake in progressive stages. First, dredges dig a trough in the lake bottom. Then rock is dumped in to form the bottom and center. Finally, the gravel is put into place to form sloping sides. In most places along its route, the earthen embankment will be 60 feet above the bottom of the lake. Heavy rock will be used to reinforce the top, to protect it from the storms that often churn up the lake's surface into rolling eight-foot waves.

If all goes according to the high-speed schedule that has been set up, the first train will cross the causeway in January, 1960. Total cost of the project, including dredging, the conveyor system, filling, and construction of the actual track roadbed, is expected to run close to $49 million. END



DROP-BOTTOM BARGE is one of 13 that shuttle between gravel-storage area and new roadbed.

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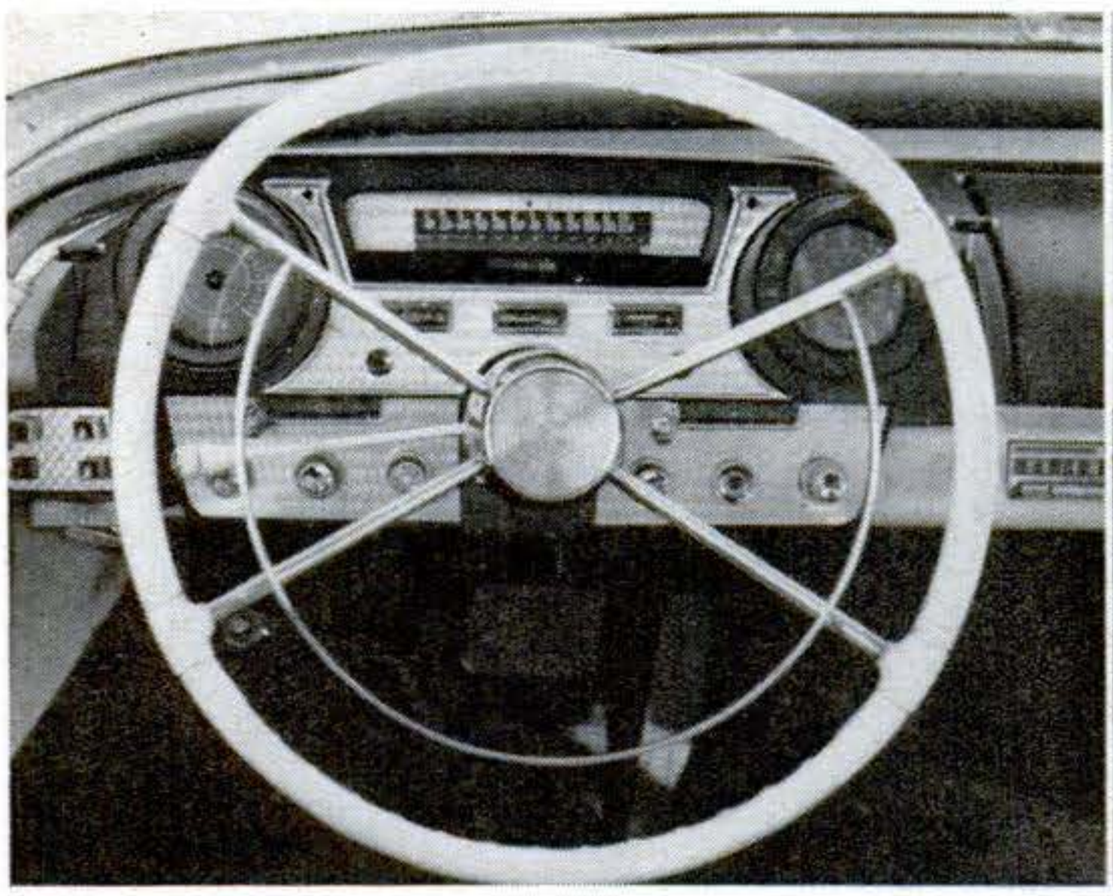
Power-operated rear window on Cruiser not only makes it easy to stow packages through back

Mercury's Turnpike Cruiser:

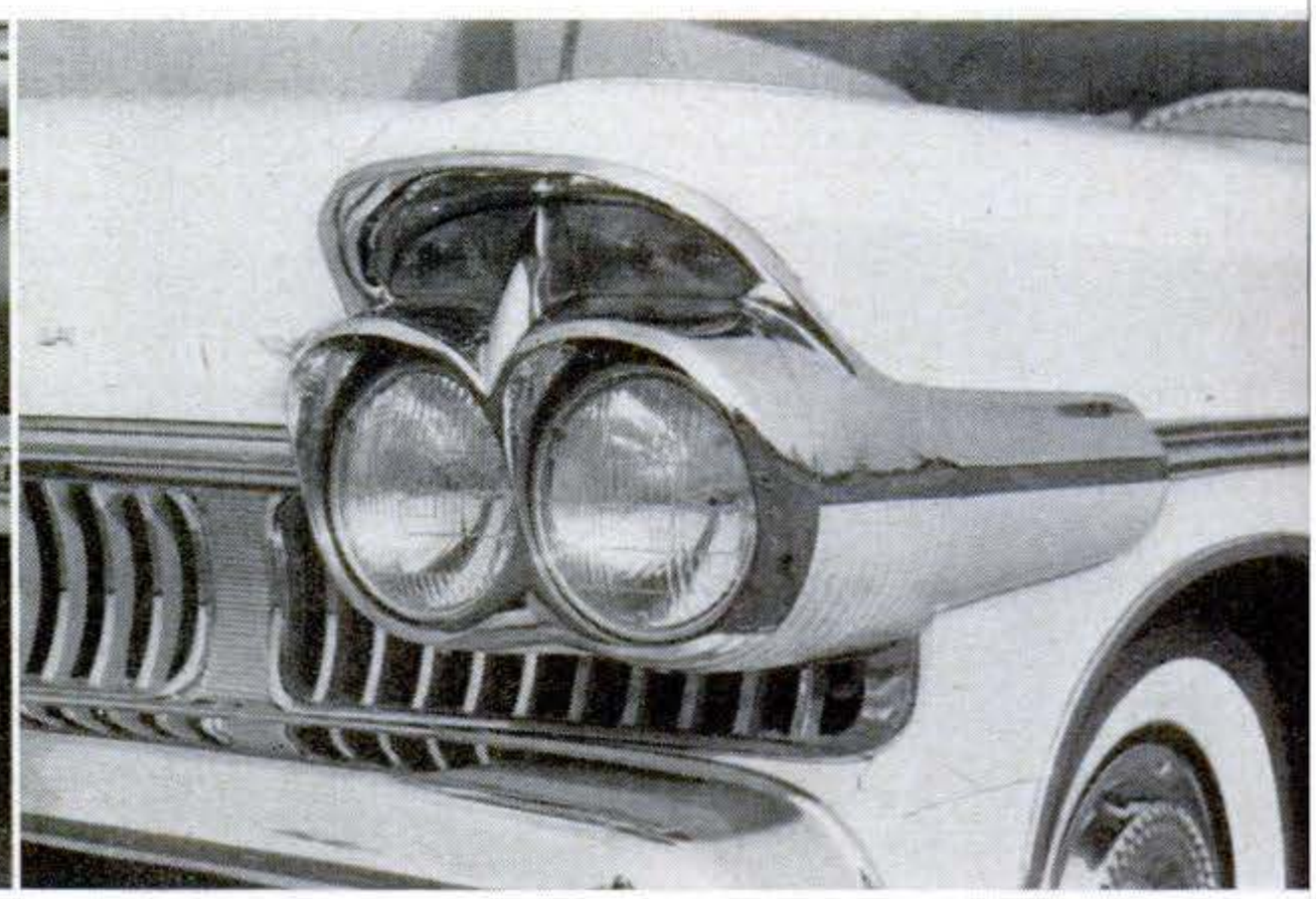
A Dream Car Joins the Assembly Line

LAST year a Mercury "dream car" was exhibited across the country. It made a coast-to-coast tour in a special glass-walled van. It was displayed in small towns and big cities. More than two million Americans saw it and said they liked what they saw.

Today, that "dream car" has moved from the world of drawing boards and models into the reality of assembly-line



CREW-CUT STEERING WHEEL has flattened top to help the driver see over it. Note the keyboard control for the Merc-O-Matic transmission just to left of the steering column, against side.



QUADRI-BEAM HEADLIGHTS are another feature. Outer lamp has high and low beams; inner lamp, high beam only. Both high beams are used for country driving, low beam for city driving.

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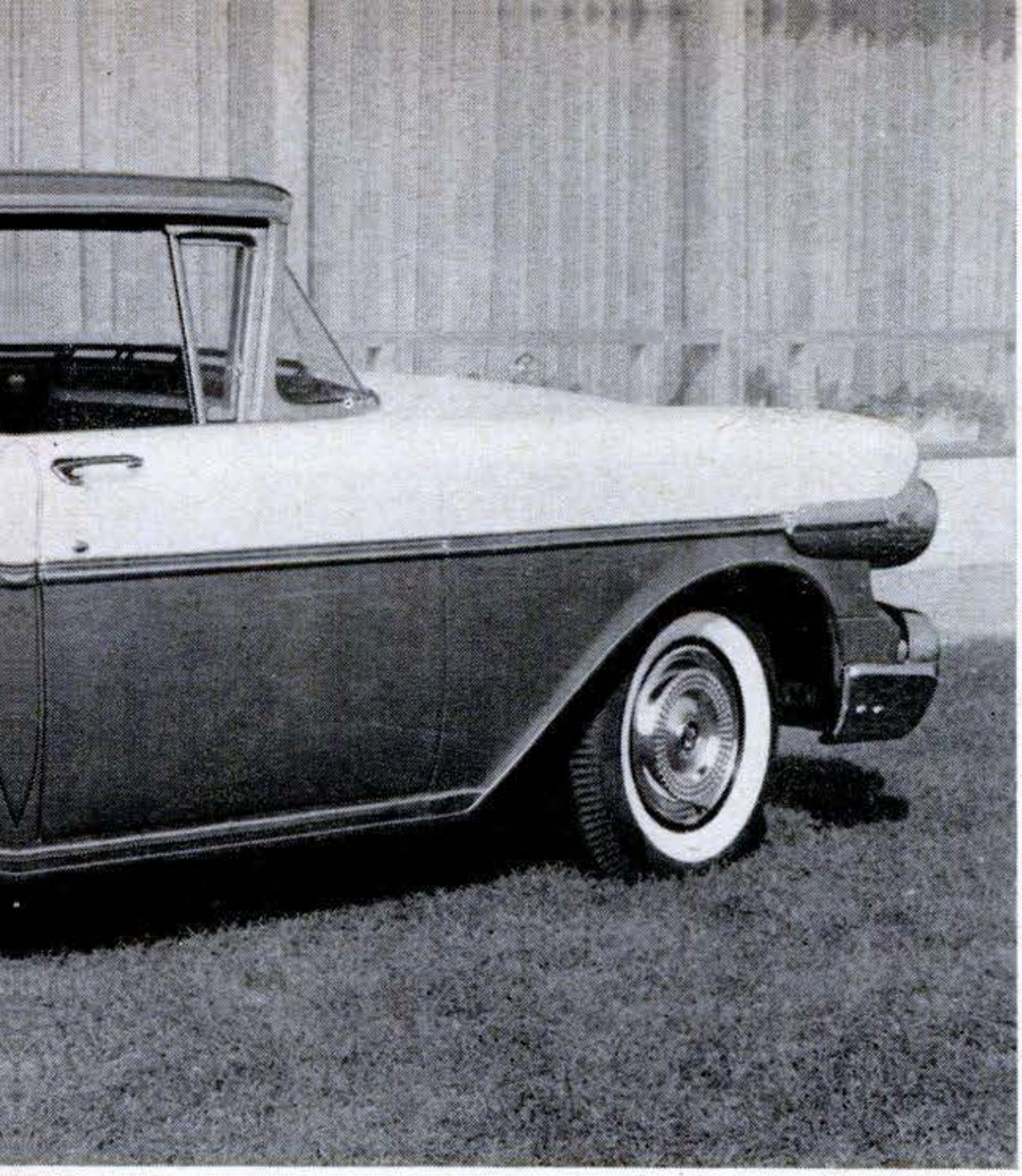
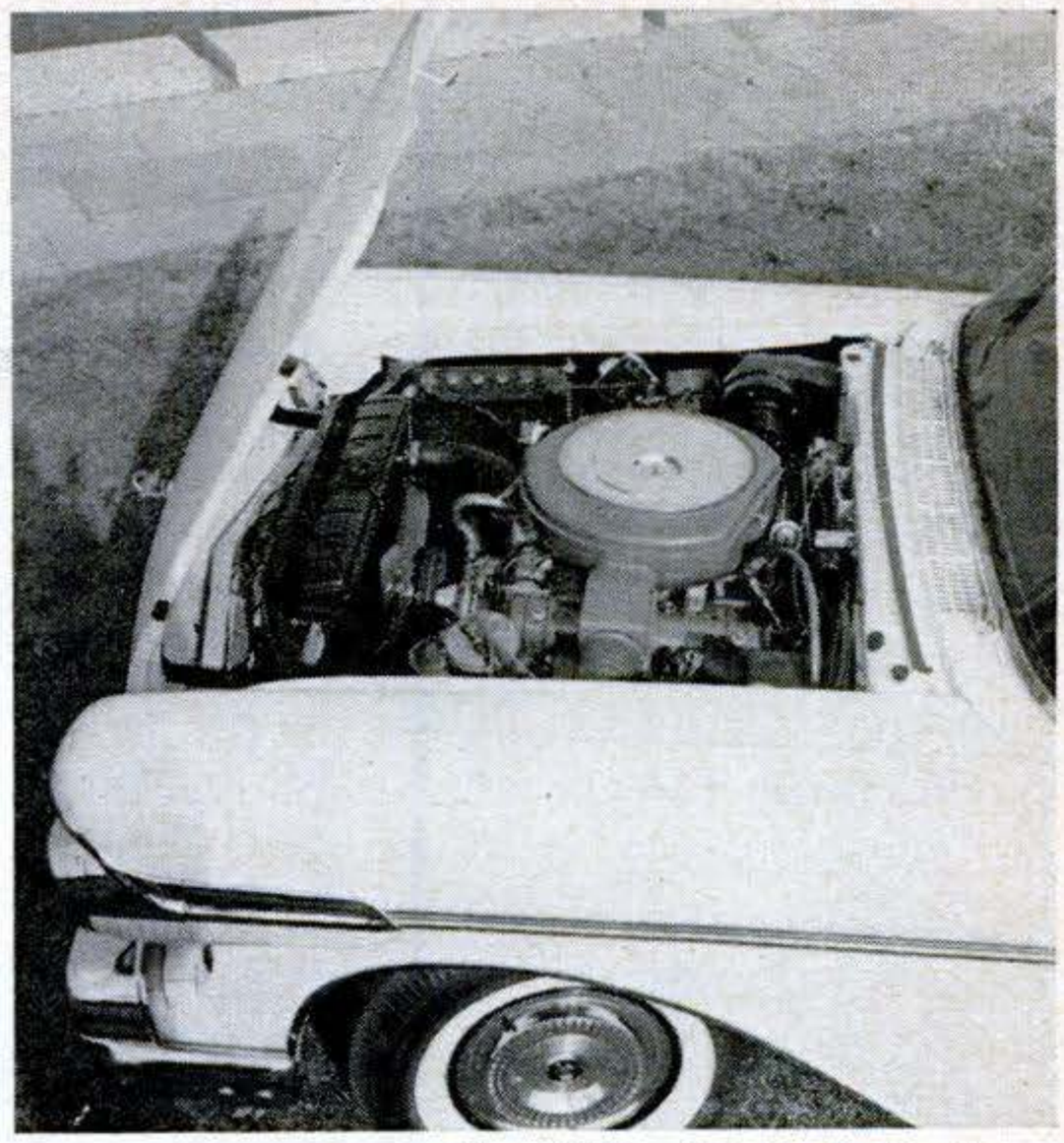
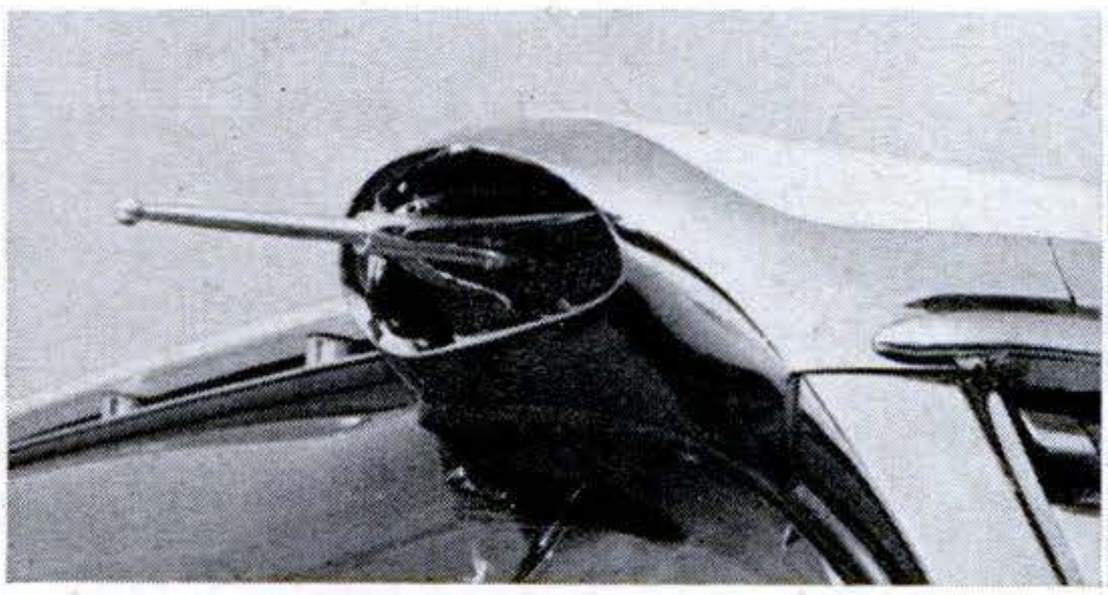


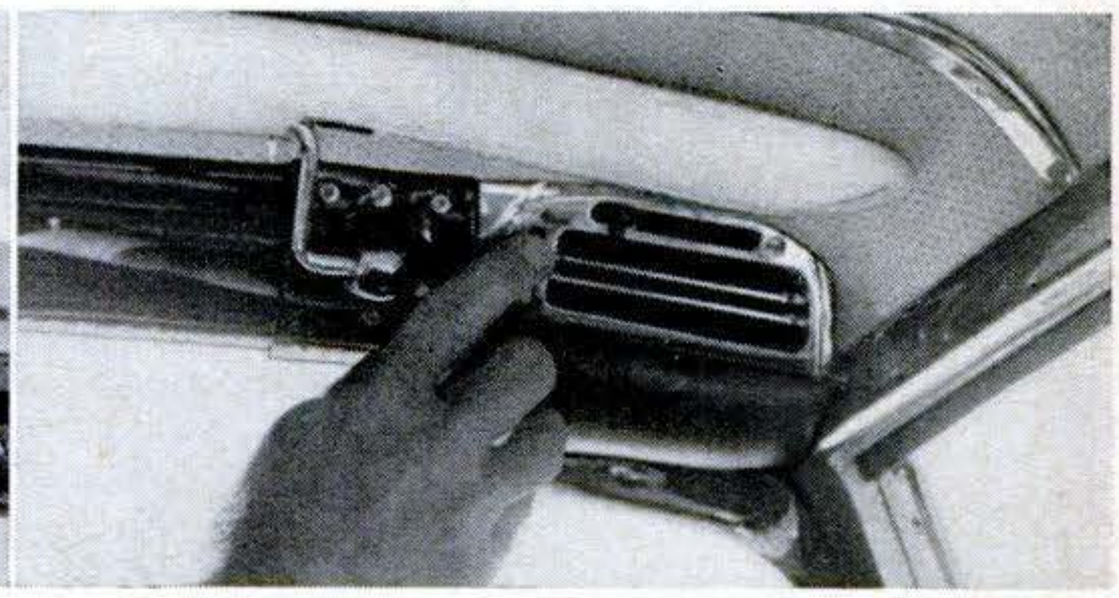
but also provides sweep-through ventilation.



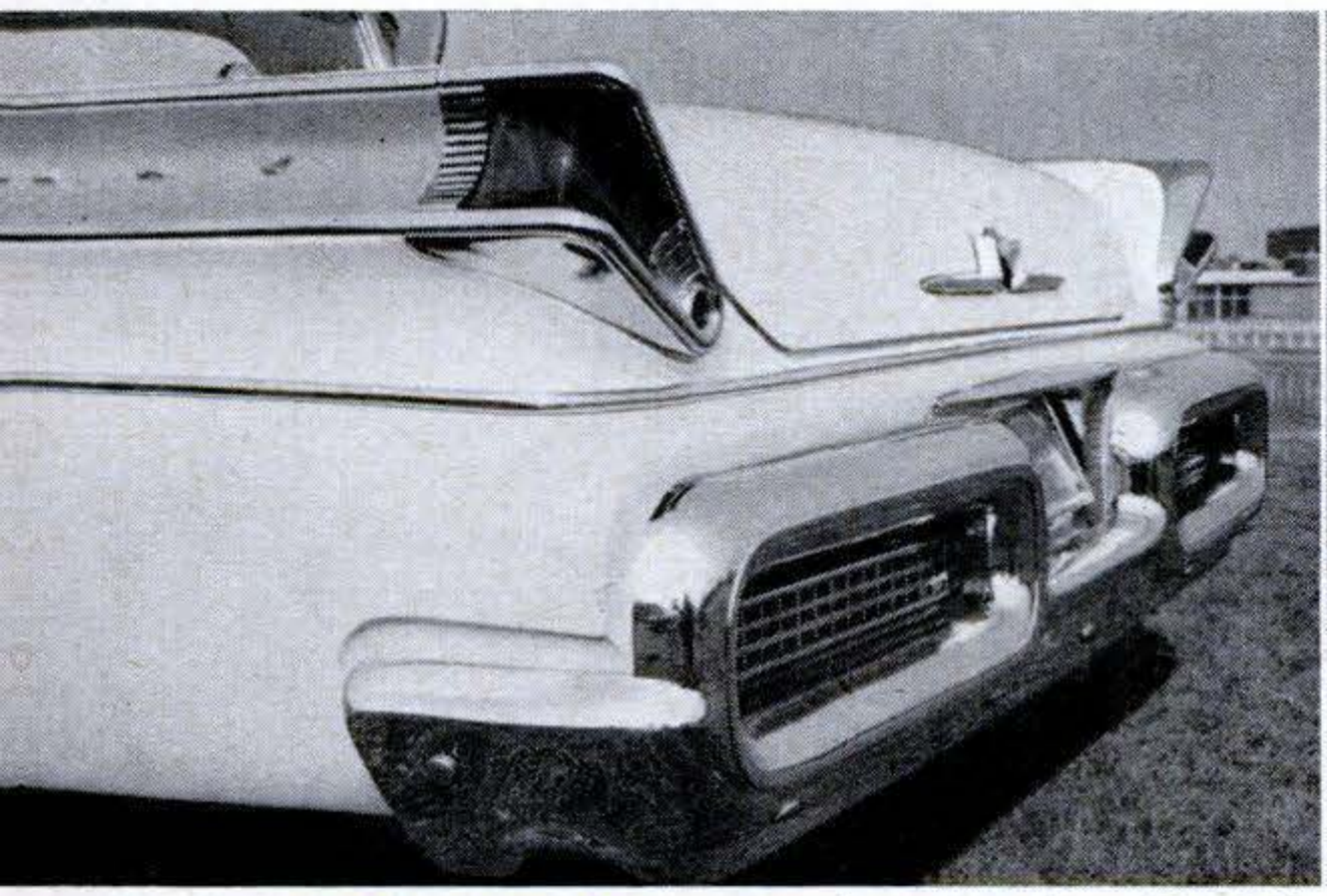
POWER A-PLENTY: the 368-cubic-inch-displacement engine puts out 290 hp. The front-hinged hood covers a full package that includes, besides the engine, front-end air conditioning and equipment for the power-operated units.



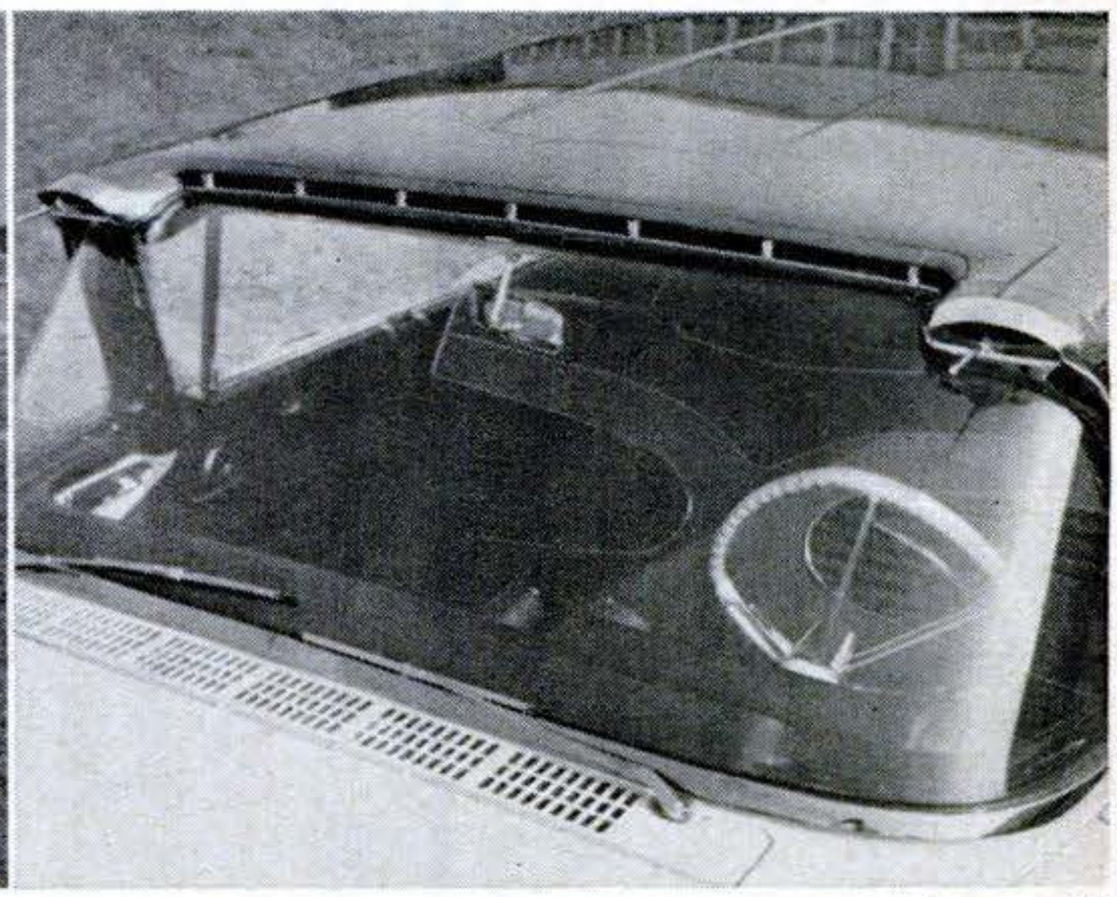
ROOF-LEVEL AIR SCOOPS, one on each side of Cruiser's double-curved windshield, suck in draft-free current of air, above traffic exhaust-fume level. Air enters the car through . . .



. . . **ADJUSTABLE VENTILATORS.** Controls on each vent allow it to open or close, while adjustable louvers control air flow and direction. Draft-free ventilation is possible even in the rain.



V-ANGLE TAILLIGHTS extend out to the sides of the body to indicate full-car width. Despite its long rear overhang, the car's 17½-foot length provides plenty of room for passengers.



DUAL-CURVE WINDSHIELD wraps upward as well as around to provide extra light and vision. Available in two- and four-door models, Cruiser is the fourth Mercury series in the 1957 line.

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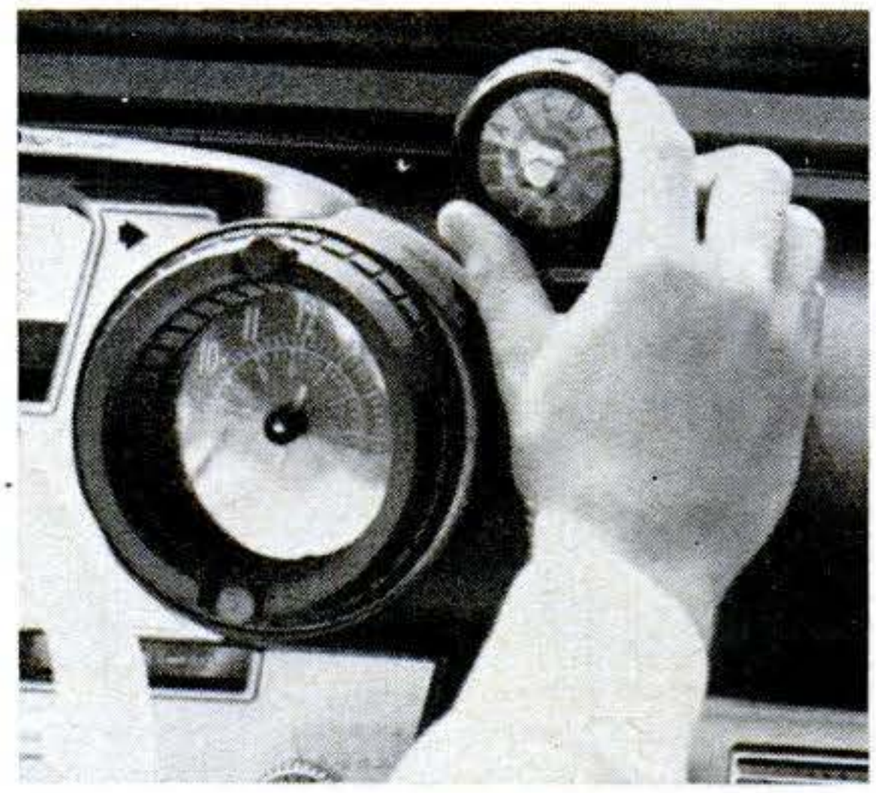
production. It is Mercury's brand-new Turnpike Cruiser.

What those two million people saw was a sneak preview of Mercury's new 1957 body-styling theme. What they couldn't see through the glass walls of the van was the array of mechanical and driving-ease innovations that Mercury engineers have managed to pack under the hood and inside the body of the Turnpike Cruiser. These weren't unveiled until the recent 42nd National Automobile Show in New York City.

Besides its 290-horsepower engine, the Cruiser boasts a whole raft of new aids to comfort and driving. These include such things as a tachometer, an average-speed computer, a "seat that remembers," quadri-beam headlights, simplified keyboard transmission control, a crew-cut steering wheel intended to give better road vision, and a new ventilating system that includes a power-operated rear window. And, if you want fewer horses under the hood, the 255-horsepower Mercury V-8 with power-booster fan is available as an option.



THE SEAT THAT REMEMBERS is adjusted by setting two indicators on this dial —one indicator for fore-and-aft movement, the other for up-and-down movement. Once set for the most comfortable driving position, the seat adjusts itself to that position whenever the ignition is turned on. When the ignition is turned off, the seat eases back and down to allow easy exit.

According to Mercury's designers and engineers, they have tried to equip the Cruiser with the extras that will make cruising—whether it be a long trip or a short one—more comfortable, safer and easier in all kinds of weather.

The new ventilating system is typical. Two roof-level intakes above the windshield scoop in the fresh air while a touch of a button close by the steering wheel lowers the power-operated rear window to let the air out. The result is a flow of draft-free fresh air even when it is raining and the side windows have been closed.

The Cruiser's dash sports three dials that will be brand-new to most car owners. One is a tachometer. The second is an "average-speed" computer clock. Consisting of a clock, a sweep second hand, an adjustable time-elapsed dial, and a mileage indicator, the computer makes it possible for the driver to figure his average speed during any period of elapsed time.

The third dial makes it easy for the driver to adjust the position of the front seat to fit his most comfortable driving position. When the ignition is turned off, the seat eases down and back to allow easy exit from the car. When the driver gets back in and turns on the ignition, the seat automatically readjusts itself to the original position set by the pointers on the dial.

A further luxury touch is concealed under the Cruiser's frame. Between the front end of each rear spring and the frame, Mercury has installed a rubber cushion permanently filled with air. These, engineers say, will absorb vibrations before they can reach the passenger compartment.

Quadri-beam headlights provide good illumination for both city and country driving. The two outer headlamps have high and low beams, the inner ones high beams only. Above each pair of lamps is a parking light and a turn signal.

In addition to previous Mercury safety features, including a padded instrument panel and padded sun visors, the Cruiser also has a steering wheel with a flattened top portion to provide maximum visibility. It also has power steering, power brakes, power windows, and a keyboard transmission control placed to the left of the steering column, on the side, within easy reach of the driver.—*George H. Waltz Jr.*

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Are You Getting Too Much Sleep?

Long a mystery, this trance that overtakes us all is giving up some of its secrets to science.

By Herbert Yahraes

Turn on TV late in the evening and what are they trying to sell you?

Coffee without caffeine . . . beverages to put lead in your eyelids . . . mattresses for spinal bliss.

Poke around in a drugstore and what do you find?

Sleeping pills, earplugs, black-velvet blindfolds . . . even lullaby records and how-to-sleep books.

Obviously the strains of modern living have a lot of us worried about getting a good night's sleep.

Why do you sleep, anyway? Are you getting enough sleep? Too much? What noises wake you up the easiest? Can you develop new sleeping habits?

RESEARCH in a number of laboratories is helping science learn more about the mystery of sleep.

We sleep primarily to rest the nervous system. Scientists know this because when we lose sleep, nothing much happens that can be measured physically. Even when people are kept awake several nights in a row, heart rate, blood pressure, temperature, metabolism, muscle tone and body weight reveal no significant changes.

The big difference comes in personal-

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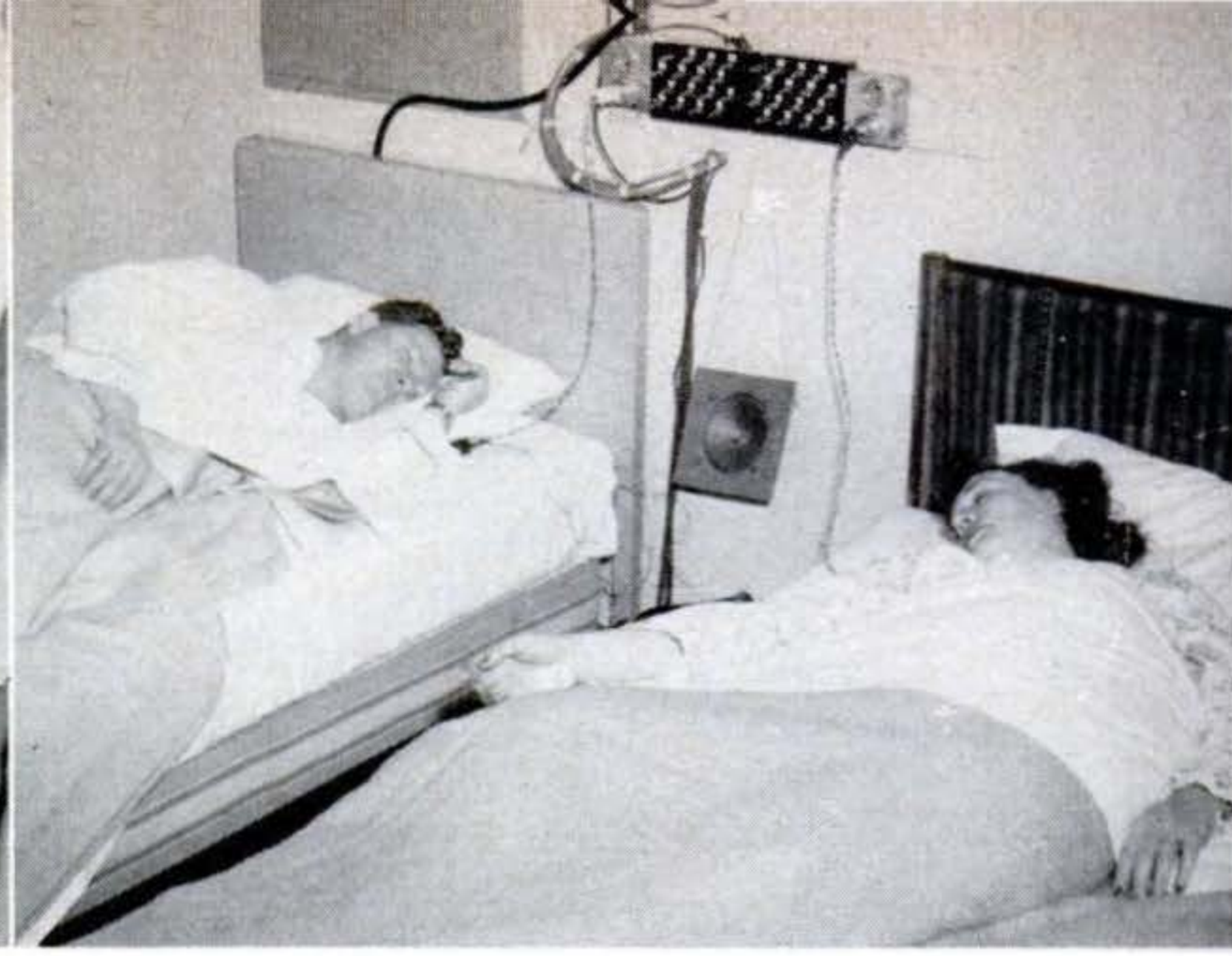
PAID $6 A NIGHT FOR SLEEPING, volunteers for Sleep Research Foundation tests quickly learned to snooze while wired. Some even got to drowsing off during the pre-sleep measurements.



FLASH-BULB SHOT in a darkened lab shows two persons snoring away for science. Braided wires running from sleepers to junction box on the wall are connected to sensitive recording gear.

ity. After staying up two or three nights, volunteers at the California Institute of Technology became irritable, even cantankerous. Some lost their memory. Those who continued to stay awake found themselves in the first stages of a breakdown. Shakespeare was plainly on the right track when he said that sleep "knits up the ravel'd sleave of care."

Too much sleep? Scientists suspect that most of us get more sleep than we need. When sailors—studied at the Naval Medical Research Institute at Bethesda, Md.—were off duty between 10 p.m. and eight a.m., they slept 7½ hours. But when they were off between midnight and noon, they slept 10 hours—because, Dr. Nathaniel Kleitman of the University of Chicago believes, they had nothing better to do.

Similarly, Kleitman found that in Tromsö, Norway, people get out of bed at the same time winter and summer. But in the summer, when there is more of interest to do and more light to do it in, they go to bed an hour later.

Dr. Brian F. Hoffman, of the State University of New York, thinks that five hours' sleep may be enough. If you got only that much, he reasons, you'd probably fall asleep faster and remain in the deeper stages of sleep longer.

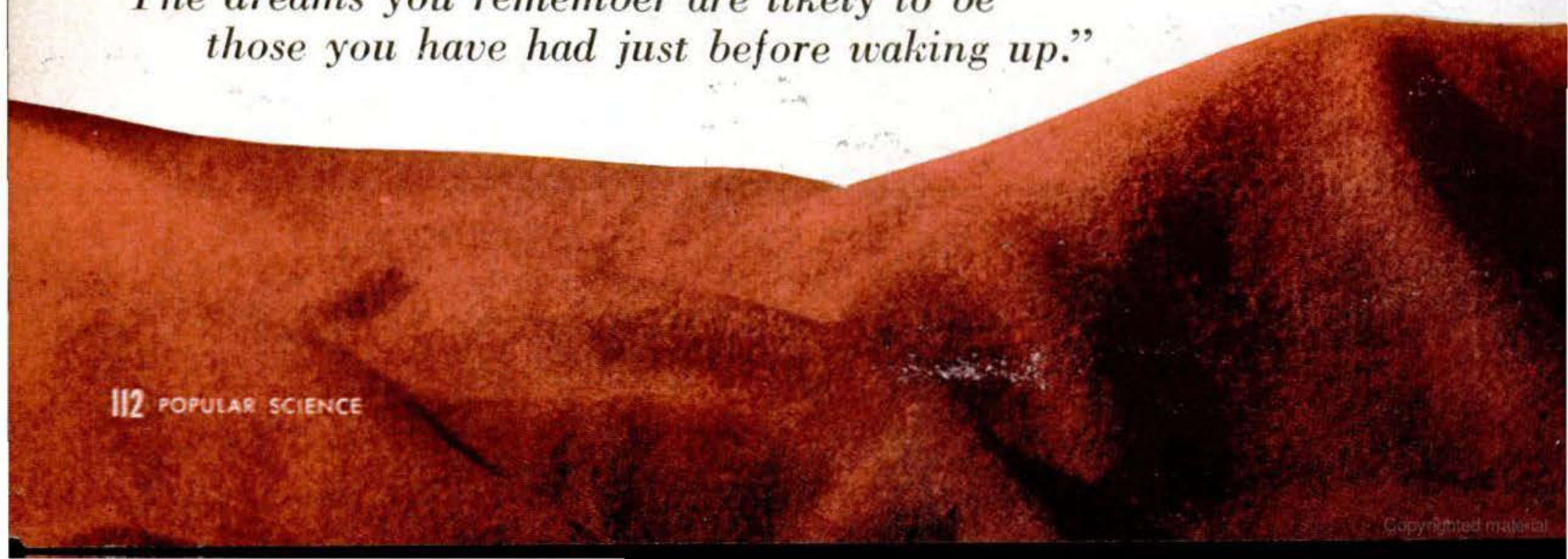
But don't we *naturally* sleep at least seven hours?

"Sleep is a protective device," Dr. Hoffman answers, "and our tendency is probably set way on the safe side."

Other authorities have pointed out that sleep is often a way of escape as well. Many a man just has to get to bed early on those nights his wife wants him to take her to a meeting.

Some need more. Science recognizes that some people need more sleep than others—or think they do, which amounts to the same thing.

"The dreams you remember are likely to be those you have had just before waking up."



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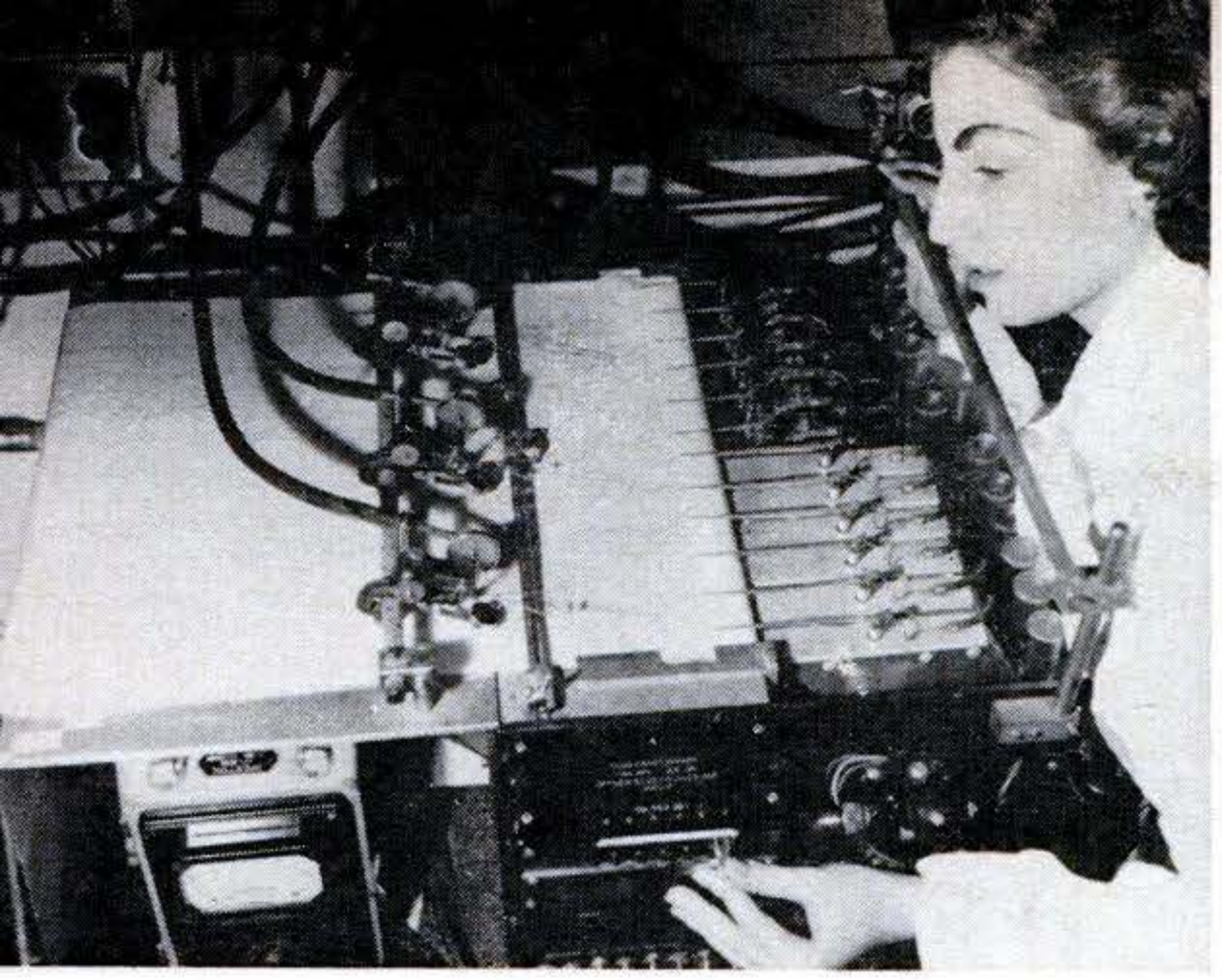

CONTINUOUS RECORD of a man's sleep is written by the squiggles these pens draw on the chart moving steadily beneath them. Analysis of the encephalogram shows how deep the sleep is.

Dr. W. H. Sheldon, of Columbia, divides people into three main classes according to build. The endomorphs or fat ones, he has reported, sleep deeply and long. The mesomorphs or muscular ones also sleep well but not for so long. The ectomorphs, who are thin folks, get only light sleep but need a lot of it. Whatever your build, say physiologists, the best rule is to get as much sleep as you need to feel good and work well.

Temperature clues. Changes in body temperature are a clue to when you sleep best. In the course of 24 hours your temperature probably varies by one to two degrees. Generally it is falling when you go to sleep, rising when you get up. Experiments by Kleitman indicate that you work best when your temperature is at its peak. But *when* this occurs varies with the individual.

So there is a scientific explanation for "evening types"—people who go to bed late, feel dreadful in the morning, and do their best work late in the day.

But the temperature curve, and its sleep-wakefulness rhythm, can be changed. Living on an artificial day of 21 or 28 hours, Kleitman's associates acquired new temperature curves and got along all right. (Kleitman's own temperature pattern changed very little and he had trouble sleeping in the daytime. This merely shows, he concludes, that some people change habits easily and others do not.)

In another experiment, people who had been staying up past midnight had to go to bed at 10. Within a week they were all sleeping well. Remarked one physiologist: "The person who says he can't go to sleep before two a.m. probably doesn't have enough to do to make him healthily fatigued."

The best bed. What kind of bed you sleep on seems to make a little difference, though you can get used to sleeping on almost anything. People tested recently by the Sleep Research Foundation voted that they preferred the firmness of a standard mattress to the softness of a feather bed. But their sleep patterns, as indicated by brain waves, were just about the same in either bed.

When they slept on hard boards, their sleep patterns were a little less deep and they moved much more often. One volunteer said he had slept fine, two said poorly, one didn't know. People *do* seem to sleep better, however, in big beds.

By and large, people sleep better alone. Or at least they move less. Sleep tests of married couples in double beds

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show that when one person stirs, the other usually does, too.

The best sleep. Brain-wave measurements prove that you get your deepest sleep during the first 80 or 90 minutes after dozing off. These waves, incidentally, are the best tool that science has found for studying sleep. In one of the most recent investigations, Drs. Hoffman, Chandler Brooks, and E. E. Suckling of the State University of New York analyzed the records of 30 men and women who slept with electrodes pasted to their heads and—to detect movement—bellows under their mattresses.

For most of the first hour and a half, these volunteers were as sound asleep as it is possible to get. They moved, but movement did not send them into a lighter phase of sleep, as it did later.

Then they almost woke up. Their brain waves resembled those of a person resting in a chair with his eyes shut. They might have responded if spoken to, though they would probably not have remembered it in the morning. In a matter of minutes they began drifting back.

This study—made for the Sleep Research Foundation, supported by a grant from the Simmons Company—indicates that a typical night's sleep curve shows three or four undulations. At the peaks you are almost awake; at the troughs, you are in sleep's deepest phase. As the night wears on, the troughs become a little less deep and you spend less time in them.

Wave patterns. What phase a sleeper is in is shown by the shape of waves in his EEG, or electroencephalogram. This is a continuous record of electrical discharge from the nerve cells of the brain.

If you stayed in the deepest stage all night long, your "sleep score"—under the system used by Brooks, Hoffman and Suckling—would be 336. The volunteers soon got accustomed to the apparatus and slept fine, but they averaged little over half of this theoretical maximum.

To sleep like a log you have to be drunk—or drugged. Normally people shift positions on an average of at least twice an hour, relieving pressure on blood vessels, nerves and muscles. If drunk they may lie in the same position

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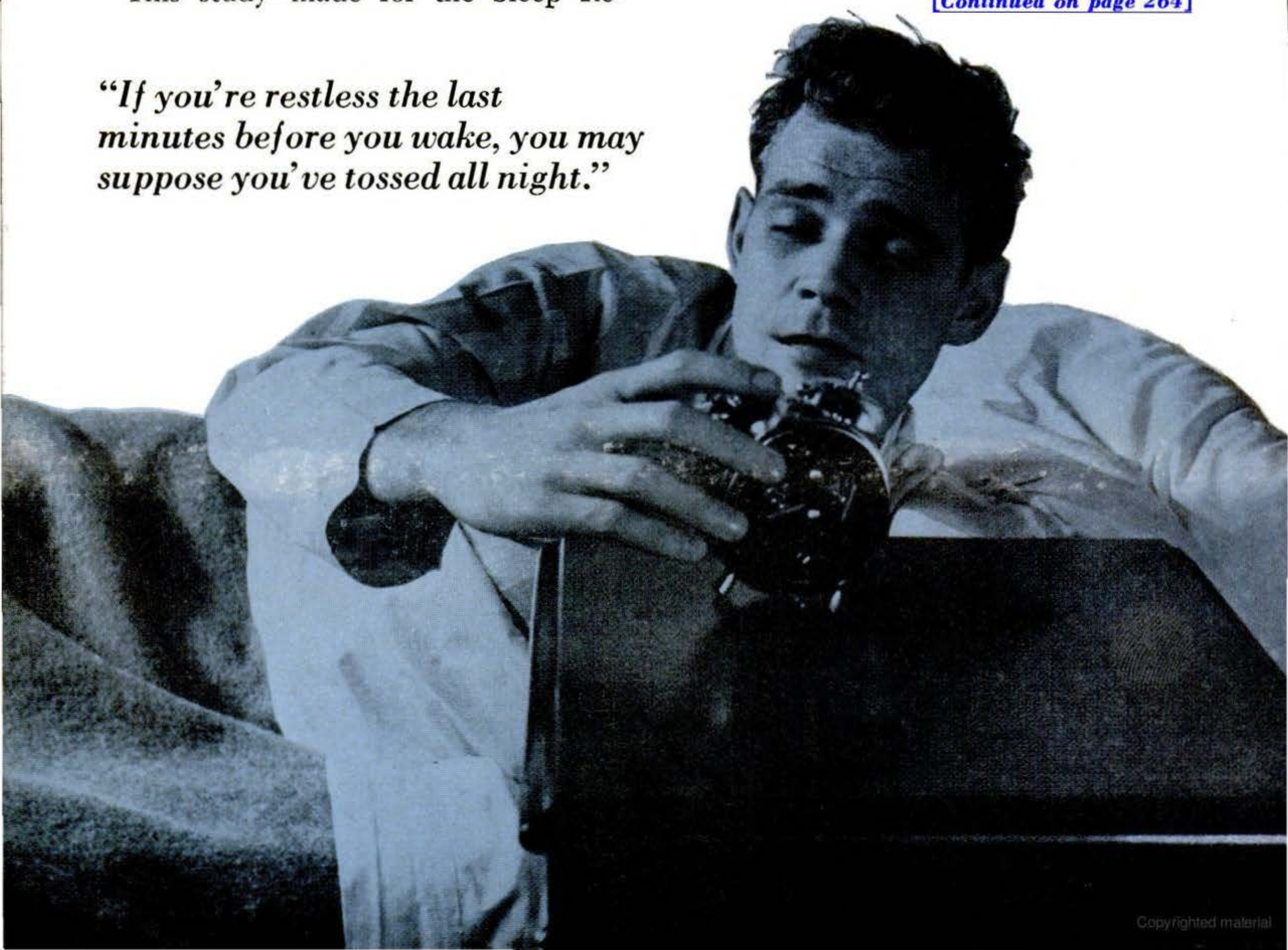

"If you're restless the last minutes before you wake, you may suppose you've tossed all night."

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From the laboratories:

The Light That Won't Burn Out

Ceilings and walls that glow brightly all over are coming from this radical new "lamp."

By Martin Mann

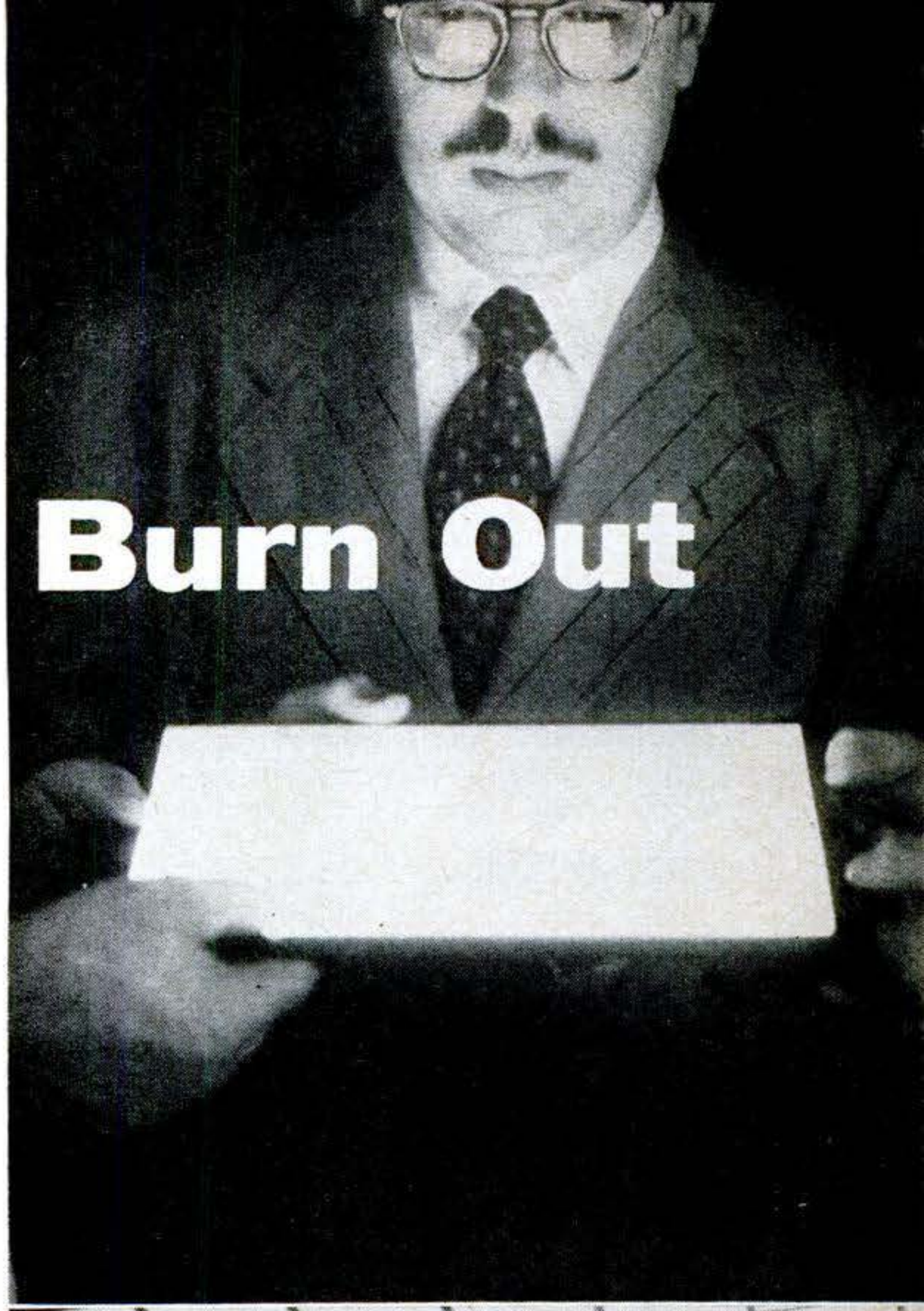
A REVOLUTIONARY new kind of electric light is here. It won't break, and it won't burn out. It glows as a bright surface, not as a line the way fluorescent lights do, nor as a point the way incandescent bulbs do.

This is electronic light. It promises rooms illuminated by walls or ceilings that glow all over—and whose color you can change to suit your mood. The lamps would be actual parts of the room, like present-day acoustical tiles.

That's for tomorrow. But electronic light is already in commercial use today. The radio dials in '56 and '57 Rambler cars are illuminated that way. So are the clock faces in Sylvania clock-radios. Two big auto manufacturers are now testing electronically lit dashboards.

The people at Sylvania Electric Products who make these strange electric lights call them "lamps." But they don't look anything like lamps. They look like pieces hacksawed off a kitchen stove. They're thin steel, with porcelain on one side. You can throw one around a table, even bang it hard against the table edge. No harm done. Plug in the wires and the porcelain side emits light.

This is a condenser, actually, a direct descendant of the Leyden jar that Ben Franklin used. It is basically like the condensers in every radio and television receiver. There are two plates, to which the electrical terminals are at-



GLOWING PANEL held by Dr. H. F. Ivey (top) is sample of the 112 lights in Westinghouse experimental room (below). These are glass; Sylvania's commercial lamps are porcelainized steel.

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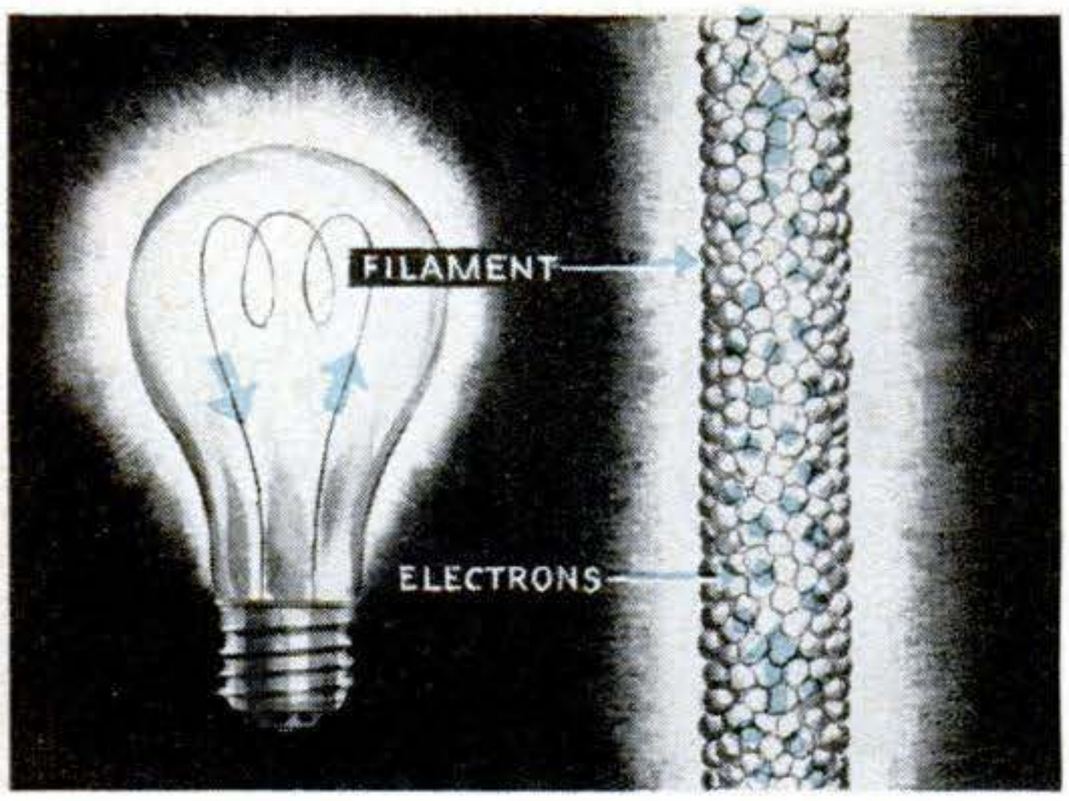
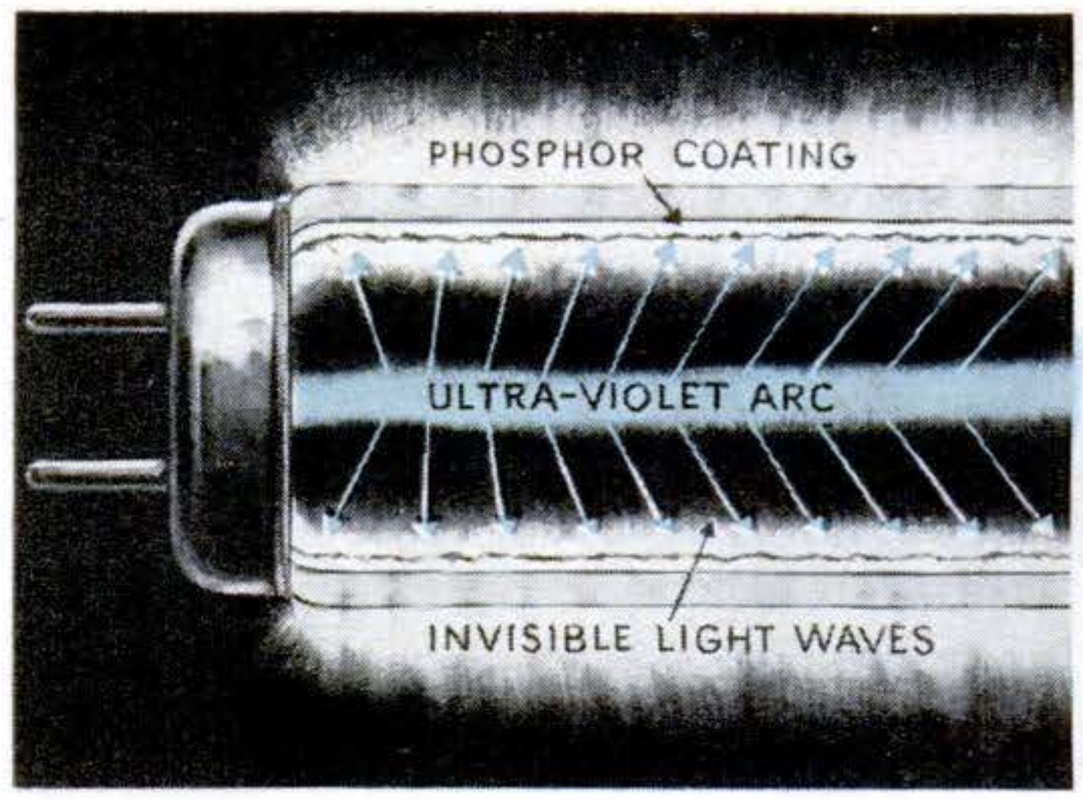
Now there are three ways to make light from electricity



INCANDESCENCE: In ordinary light bulb, electric force pushes electrons through thin filament. Friction makes the filament white-hot.



FLUORESCENCE: Electrically excited mercury atoms emit ultraviolet light. These light rays strike phosphor, which produces visible light.

tached, and in between the plates is a dielectric material to help store electrical energy.

Now, ordinary condensers never light up. The difference here is the dielectric material, which contains a phosphor, a chemical that will emit light when you tickle it the right way. In this case the tickle comes from the electric field between the condenser plates. One of the plates is transparent, so that the light can get out.

In the electronic lamps now on the market, the steel forms one plate of the condenser. The other, transparent, plate is a thin film of tin oxide, which conducts electricity. The dielectric in between is ordinary porcelain, but it contains zinc sulfide phosphor.

Sturdiness that no one ever thought a lamp could have is only one advantage. Among the other advantages:

• Shape. Usually you want to light a surface—such as a desk top—but must start with a line or point source of light. The electronic lamp already is a surface, so you don't need expensive fixtures to spread its light pattern.

• Life. Some electronic lamps have been left on continuously since 1951—52,000 hours. They still deliver light. There are no filaments or cathodes to burn out, and these lamps never burn out the way that other lights do. As time goes by, their light output decreases gradually, perhaps by as much as half after 10 years.

• Color. Different materials make electronic lamps of different colors. But you can also change the color of the light from a single lamp just by changing the frequency of its AC power supply. This suggests a color-control knob for the electronically lit room. In hot weather you adjust the frequency so that your luminous ceiling glows a cool green; in cold, gloomy weather you flood the room with warm, yellowish light.

There's a catch to all this, however. Electronic lamps are wonderful, but the glowing ceiling is not very practical right now. There are two basic difficulties that only research can overcome:

• Brightness is one. The Sylvania lamps on the market are low-level lights, bright enough for dials and signs. But nobody, now, would use any of these lamps to read by.

• The other difficulty is with efficiency. The best electronic lamp that Westinghouse has made needs twice as much electricity per unit of light output as even an incandescent lamp does, seven or eight times as much as a fluorescent. And that's an experimental job. Commercial models are even less efficient.

The future is very promising on this score, however. Incandescent and fluorescent lights are now nearly as efficient as they can ever be. Electronic lamps can be tremendously efficient. Theoreti-

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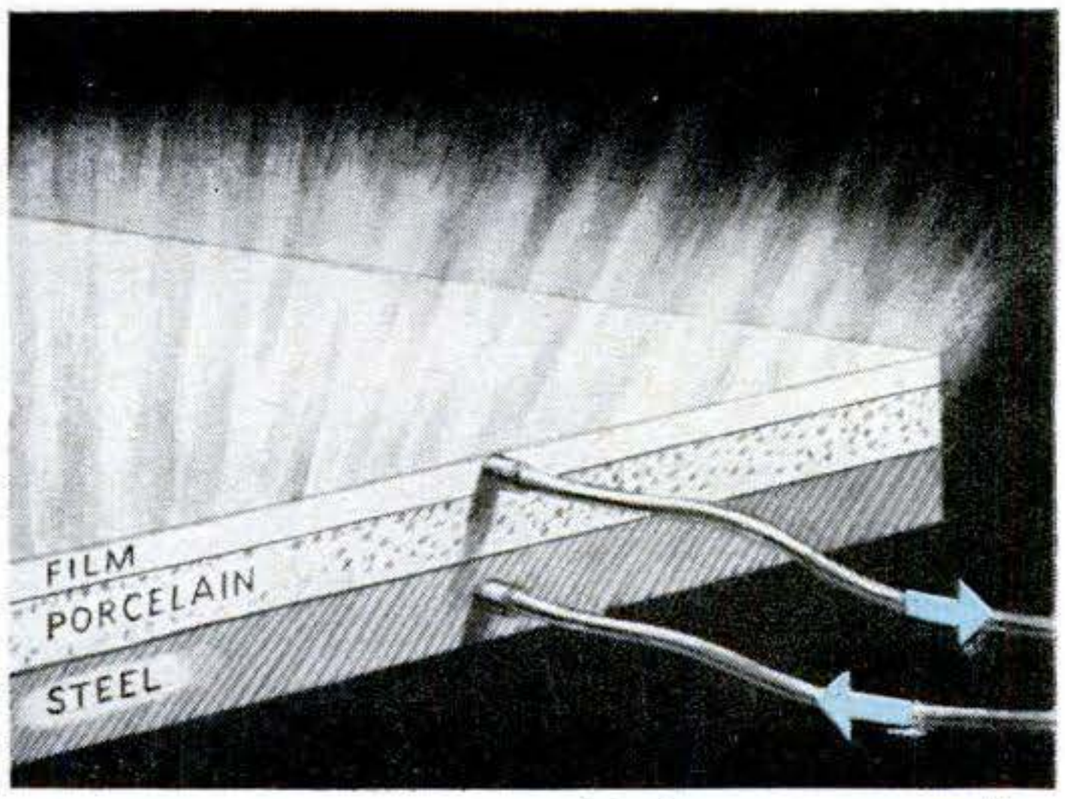

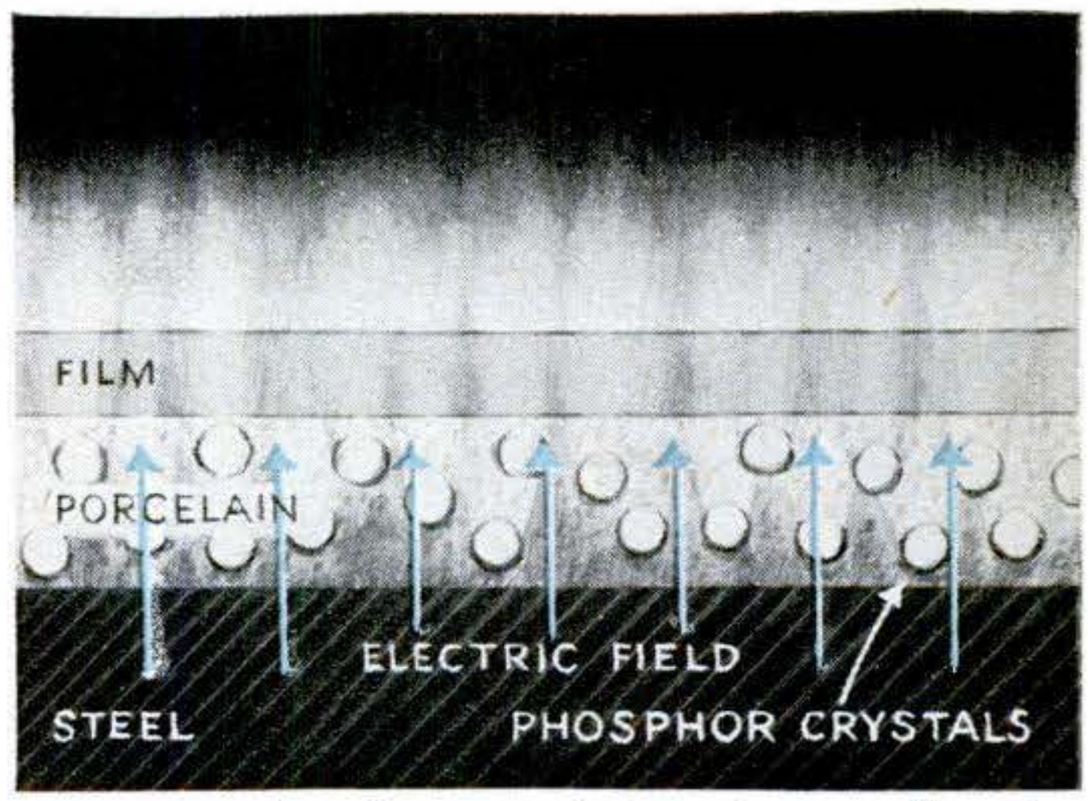

ELECTROLUMINESCENCE. This lamp is a condenser—one plate is steel, the other transparent film. Electric field between plates frees electrons in phosphor-porcelain mixture, shooting them into phosphor crystals. These freed electrons strike phosphor atoms, which emit light.

cally they could be 2½ times better than fluorescents, more than 10 times better than incandescents.

Higher brightness is the big problem, because that's what room illumination needs. You can make electronic lamps bright by operating them at high voltage or high frequency or both.

Westinghouse showed off last fall a mock-up room that was as brightly lit as you would want. It had 112 electronic-lamp panels covering the ceiling and most of the walls. But the power supply was 350 volts, 3,000 cycles. That's not what you want around your house. So the hunt is on for phosphors and dielectric materials that will deliver more light with a reasonable power supply.

How it works. You can see why higher voltage and frequency increase brightness if you look inside an electronic lamp. Since it is a condenser, it generates a field of electric force between its two plates.

Every time the field changes (alternating current) it kicks loose electrons from the edges of the phosphor crystals. These electrons shoot into the phosphor crystals, bang into atoms and transfer their energy to the atoms. The atoms release this newly acquired energy in the form of light.

Higher voltages make more powerful fields. So less-willing electrons get kicked loose. Higher frequencies mean the kicks come more often, increasing the opportunity for electrons to be freed.

This phenomenon of electronic light caused by a varying field has a seven-

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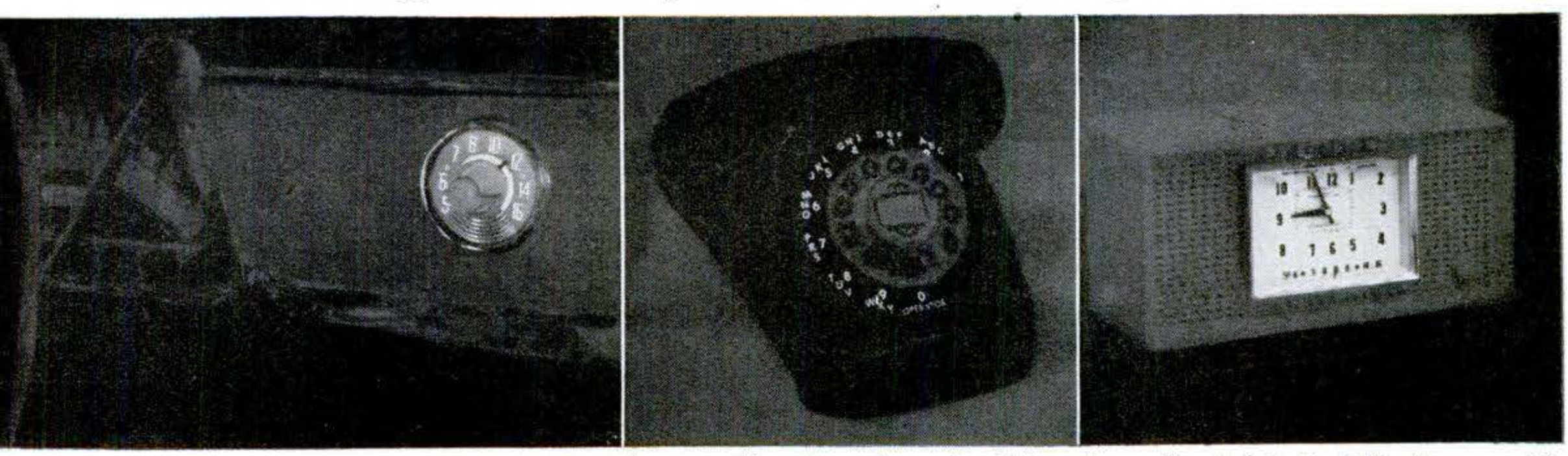
Electronic light is already at work illuminating dials



ELECTRONIC LIGHTS YOU CAN BUY NOW illuminate radio dial on Rambler cars (left) and clock face in Sylvania radio (right). Telephone with electronically lit dial should be available soon.

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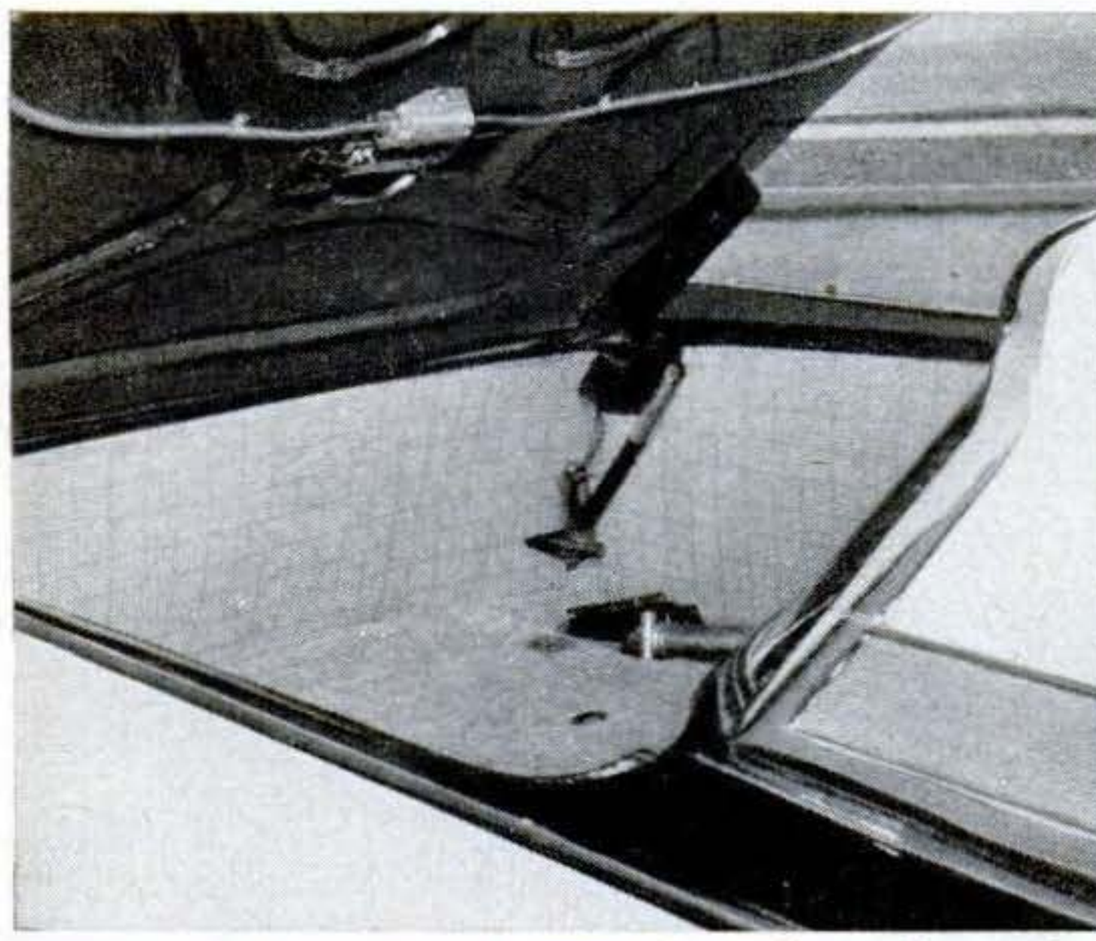
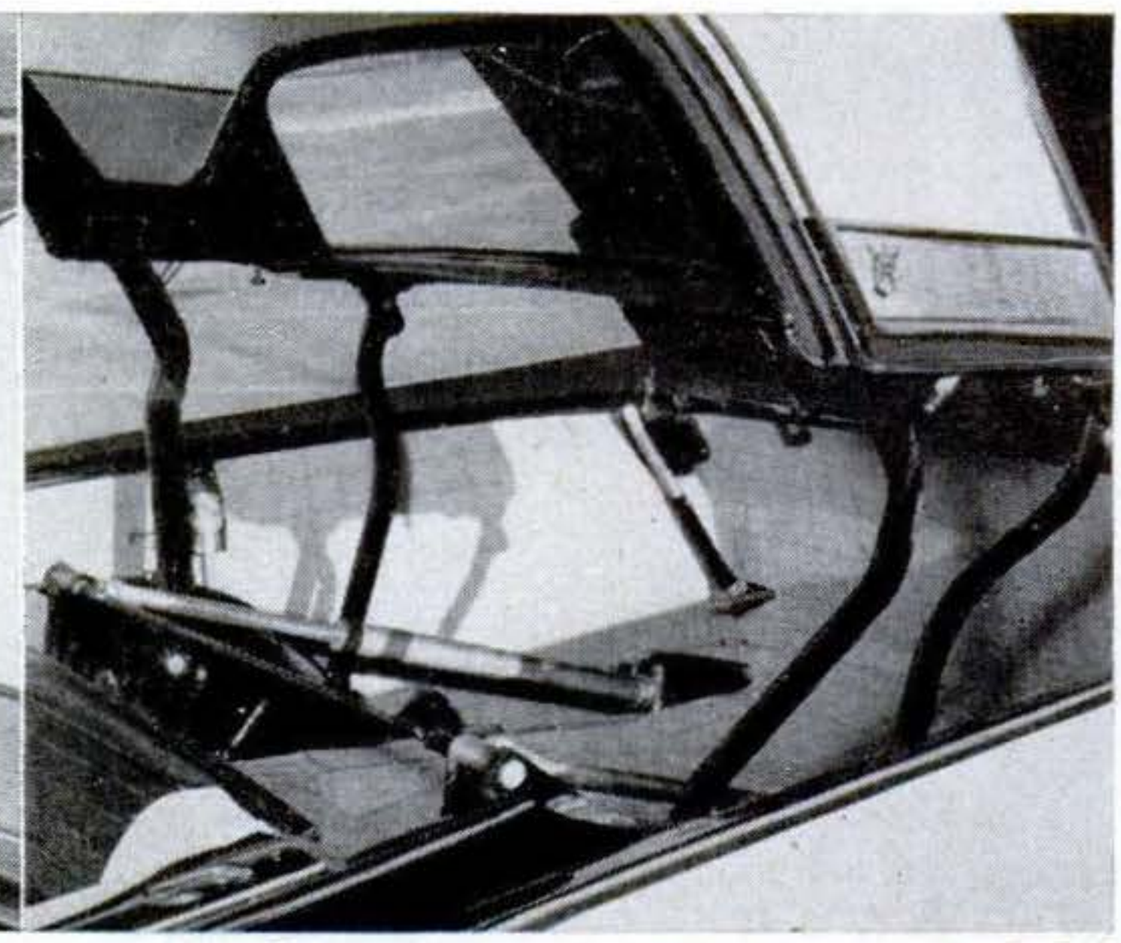
It converts the hard way: **Detroit's First Collapsible Hardtop**





SCREW JACKS AND LEVERS in enlarged trunk raise or lower the top—a 40-second operation. Ten inches of 90-inch-long top fold under to simplify things. Hinged projection on deck lid flips out to cover package-tray aperture when the top is down. Spare tire is under the floor.

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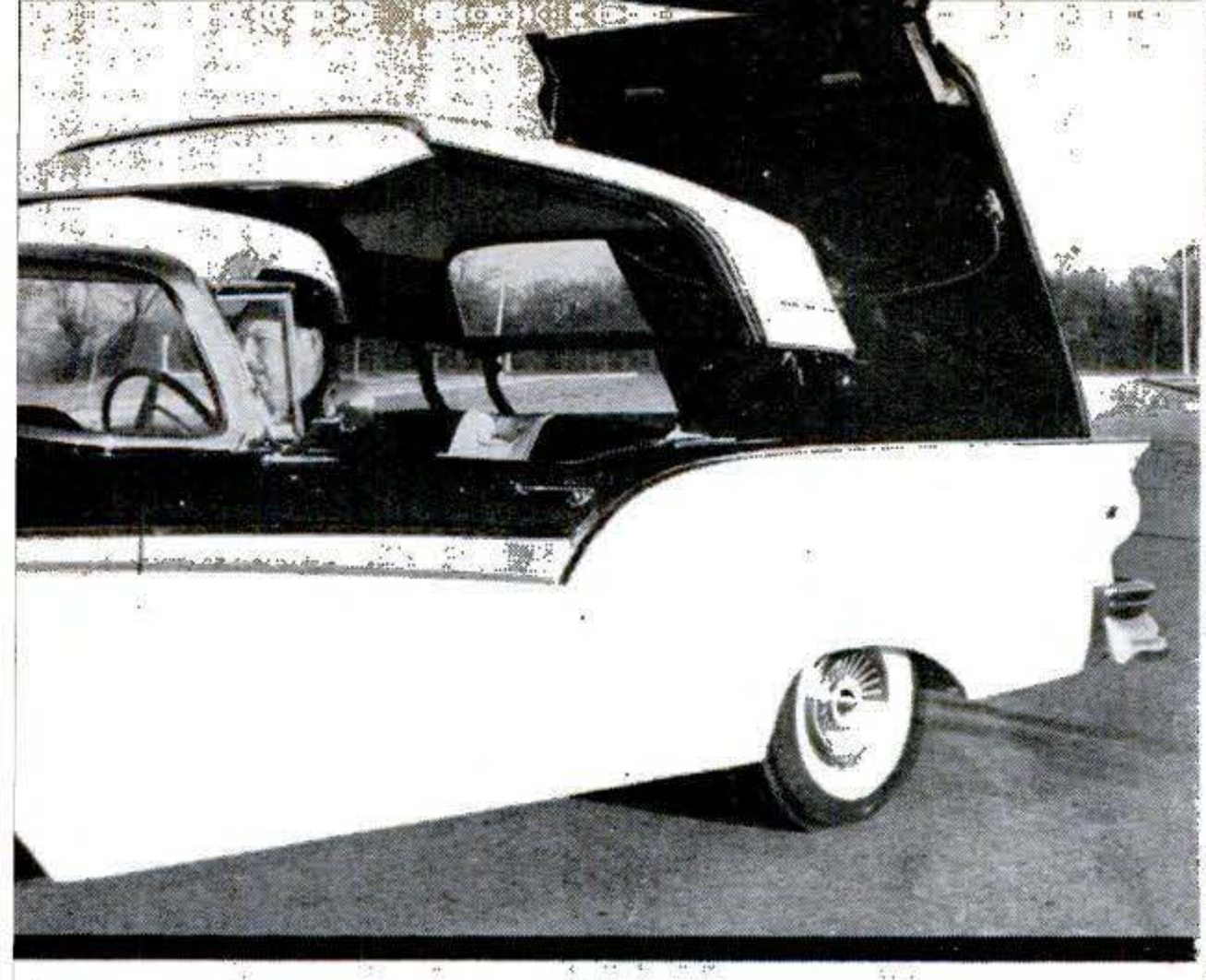

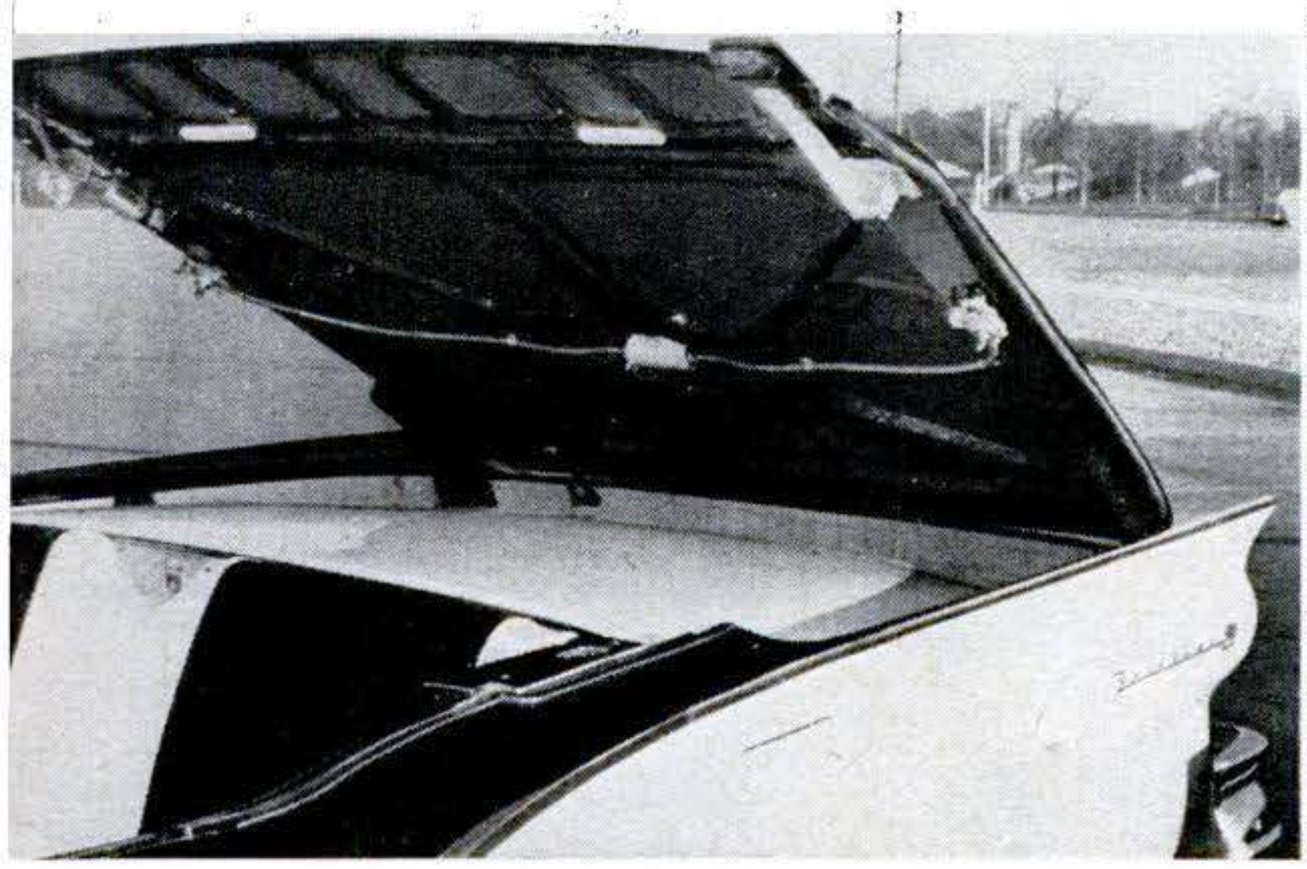

...actually becomes a convertible hardtop

FIVE years ago a bunch of guys at the Ford Motor Co. tackled the job of taking the steel roof off of a hardtop convertible. Last month, grim-faced and sweaty, they announced the result.

They not only took it off. They put it back on. Then they took it off again. Did it all just by pushing and pulling a button, too. Which is to say that Ford has produced a hardtop "convertible" that actually converts.

Its hard steel top rears up, slides back and disappears beneath a glossy poop deck as a submarine is embraced by an ocean wave. The effect is awesome.

The only commercial car of its kind, the convertible hardtop convertible is a magnificent piece of engineering. To lower the top, stow it under the deck lid and raise it again takes eight motors.

There are locks of the screw-driven type, and counter-balancing devices, and safety things so that the top won't shed its moorings and go sneaking off into the stern while the car is doing 80.

If you ask the Ford people what the new hardtop will cost when it's put into production this month, they reply with a hollow laugh, which sounds pretty ominous. END

This multiple-exposure photograph shows progressive positions of the top as it is lowered.

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It tunes speaker enclosures just right—by ear

A low-frequency glide band makes it easy to adjust the reflex port, detect faulty construction and smooth out speaker response

It tells how quiet or noisy a turntable is

Silent grooves, cut on the quietest recording lathe known, reveal rumbles in disk-turning mechanisms

It shows up worn stylus or poor tone arm

By sound alone, tone bands tell whether your stylus is defective or tone-arm resonance too high

It tests the setting of equalization controls

One special band helps set equalization or tone controls to match the standard recording curve

It challenges you to name common sound effects

A quiz band of everyday noises makes an amusing party game—and reveals how good a system really is

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Test Platter

This Record Checks Out Your Hi-Fi System

Here's an audio tool that puts a finger on your system's pulse, listens to its heart, and diagnoses its ailments.

By Hubert Luckett

THIS test record is something new: It turns sound itself into a hi-fi engineering tool. You can *listen* your way to a better music system.

If you are building your own speaker enclosure, this record will enable you to tailor the reflex port just right to get top performance from whatever speaker you have. If you have a working hi-fi rig but think it could be better, you can check out its components by listening to this record—and make them better. If you are interested in buying a hi-fi outfit and wonder just how good it really is, this platter is for you. It will:

- Tell you exactly how to tune a bass-reflex speaker enclosure for smoothest performance;
- Detect faulty cabinet work that your eyes may have failed to notice;
- Pin down speaker performance and tell you whether it matches up to claims;
- Put the finger on turntable rumble;
- Check your stylus and cartridge for wear and misalignment;
- Spot resonance in your tone arm.

BUT that's not all. There is a band to help you set amplifier controls to match the RIAA (Record Industry Assn. of America) recording curve, so that you will hear the music as actually played. The disk also has a precise 440-cycle musical A tone for tuning musical instruments—or checking turntable r.p.m.'s to a split turn. One special band is for setting tweeter level to match that of mid-range and woofer speakers in three-way systems.

As an extra, there is a band of five music-box selections, recorded from a Regina (vintage about 1890) that plays interchangeable steel disks. The elaborate orchestration of these pieces sounds pleasing on almost any system. But on a really wide-range rig, you can almost see the reeds quiver as you listen.

And just for fun, there's a whole band of familiar sound effects to test your auditory recognition, some with nostalgic overtones. It would spoil the fun to name these noises, but after you've checked yourself out on them, you can try them as a quiz game on your friends.

Familiar noises are a good hearing

JUST BY LISTENING to the special band on this record, you can evaluate speaker performance —and then improve it by experimenting with the reflex port and adding acoustic damping.

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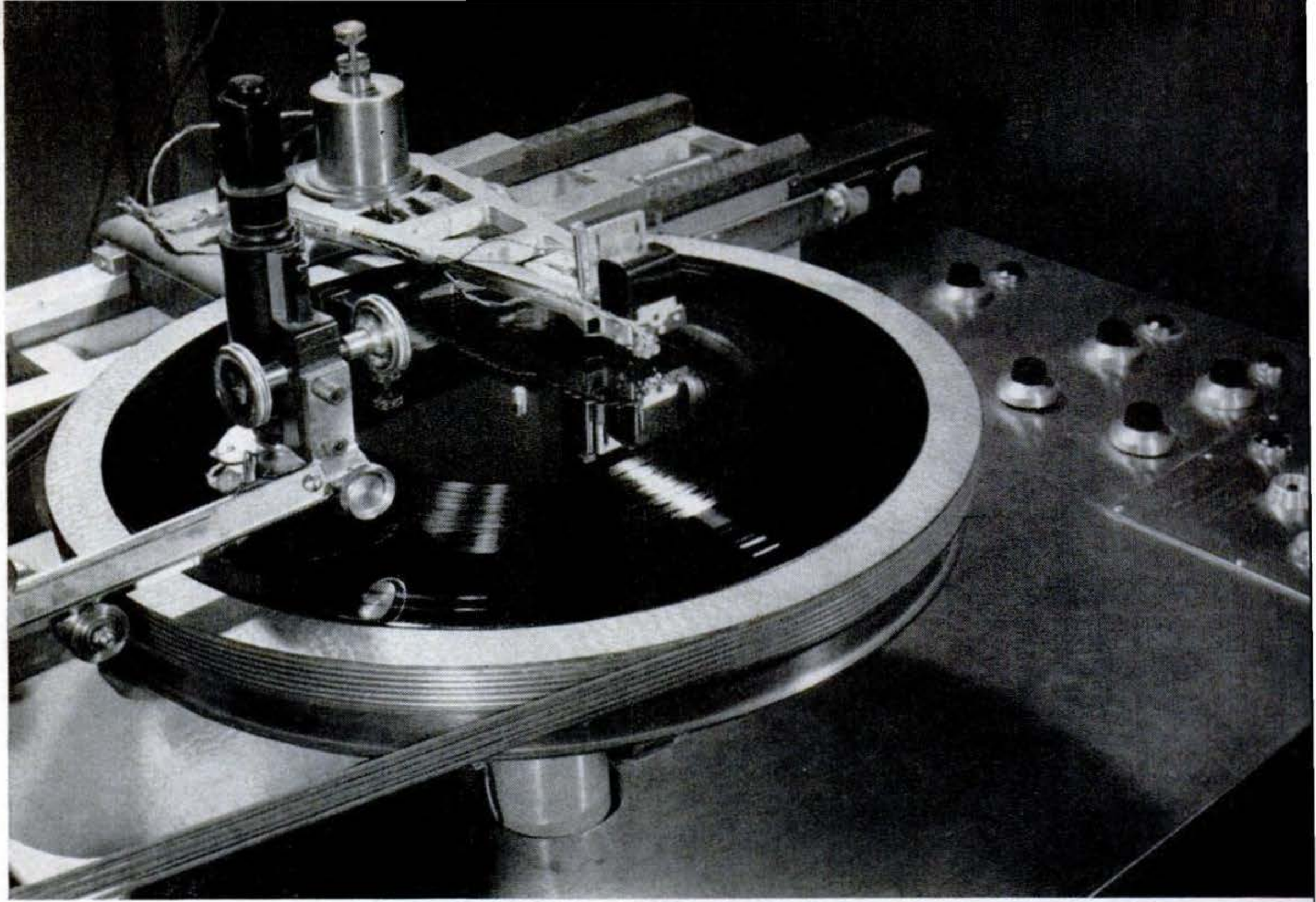

NO LEAD SCREW is employed in the Hydrofeed recording lathe. Its cutter head is traversed across the disk by a piston in an oil-filled cylinder. With constant hydraulic pressure on one side of the piston, movement is controlled by a metered flow of oil from the other side.

test of a reproducing system because they are a sampling of random frequencies. If your hi-fi rig favors one frequency over another, the effect will sound unnatural and be harder to identify. If you can name these sounds on the first hearing, your system and your ears are probably pretty good.

THE speaker-enclosure tuning band, only one of its kind yet recorded, is a 300-to-20-cycle glide tone repeated over and over, with a cricket-snap sound every 50 cycles. You need only one piece of electronic equipment with it: a 10-cent resistor of any value between 50 and 200 ohms.

Connect this in series with the speaker, play the glide band fairly loud, and you'll be able to hear, feel and even see bass resonance peaks (the point at which the voice coil and cone develop an excessive vibration and therefore an artificial and unnatural volume of sound).

You first determine this resonance point with the speaker unhoused, lying on the bench. Then—still with the help of the glide band—you can tailor the reflex port to split this peak into two, one higher and one lower than the free air resonance, and finally eliminate the first altogether if you wish. The result is an enclosure that gives your speaker a chance to turn out the best performance it is capable of producing.

Thin, bouncy cabinet walls or backs can make sound fuzzy or introduce spurious sounds of their own. Such parts can be detected with the fingers by playing the same glide band at high volume. Once found, they can be remedied by such simple dodges as adding braces, blocks or extra wood screws.

Another helpful band on this unique test record has perfectly quiet grooves which aren't quiet at all if you have turntable rumble. A poor turntable can make this band sound like a subway train; on a good one, you hear beatific silence.

Ever wondered how good your equalization control really is? Or (if you don't

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PRESSINGS ARE MADE by the monofusion process. Using full-sized vinyl "biscuits" insures that every record made will be top quality.

How to Order Your Popular Science Hi-Fi Test Record

THIS *unique disk is available at present only directly from* POPULAR SCIENCE, *at $2.50 for one record or $4 for two. Full instructions for its use are included.*

You may want two. The extra record makes an unusual and highly welcome gift for any hi-fi fan, present or to be. Or you may want to keep it, unplayed, as a reference standard to check the one you use regularly.

Send cash, check or money order to Record Dept., POPULAR SCIENCE MONTHLY, *353 Fourth Ave., New York 10, N. Y.*

have one) how best to set bass and treble controls to approximate the RIAA curve? A band of announced frequencies helps you do just that.

Identical 1,000-cycle tones recorded at the same level but at the extremes of groove velocity (one an outside band, one an inside) will show up a worn stylus by the difference in sound. On another band, a high-level glide tone will detect any tone-arm resonances.

PAINSTAKING care went into making the record. Each sweep in the speaker-tuning band had to be uniform in pitch, amplitude and timing. The original sweep was therefore first recorded on tape, a loop was made of the tape, and it was run through repeatedly to cut the master.

Elaborate precautions were taken in recording the 440-cycle musical tone. This originated from WWV, the U. S. Bureau of Standards station. Two oscilloscopes were used, and the turntable of the recording lathe was controlled to run at exactly 33⅓ r.p.m. If you suspect your own turntable of running off speed, compare this 440-cycle tone with that of WWV (which you can get on a short-wave receiver) or that of a tuning fork.

The sound effects were first recorded on high-fidelity tape and then transferred to the master. Some are magnified or close-up sounds. As you'll guess when you hear these sounds, the props to produce some of them were hard to find. But all are the real thing.

The master was cut on the Hydrofeed recording lathe, an ingenious mechanism that produces the quietest groove known in the industry. Pressings are made of pure vinyl by the monofusion process, which preserves all the high quality of the original recording.

The POPULAR SCIENCE Hi-Fi Test Record is one you'll want to keep a long, long time to run periodic checks on your equipment. With it, you can make sure that your hi-fi is delivering its very best today—and that it will still be doing so tomorrow. END

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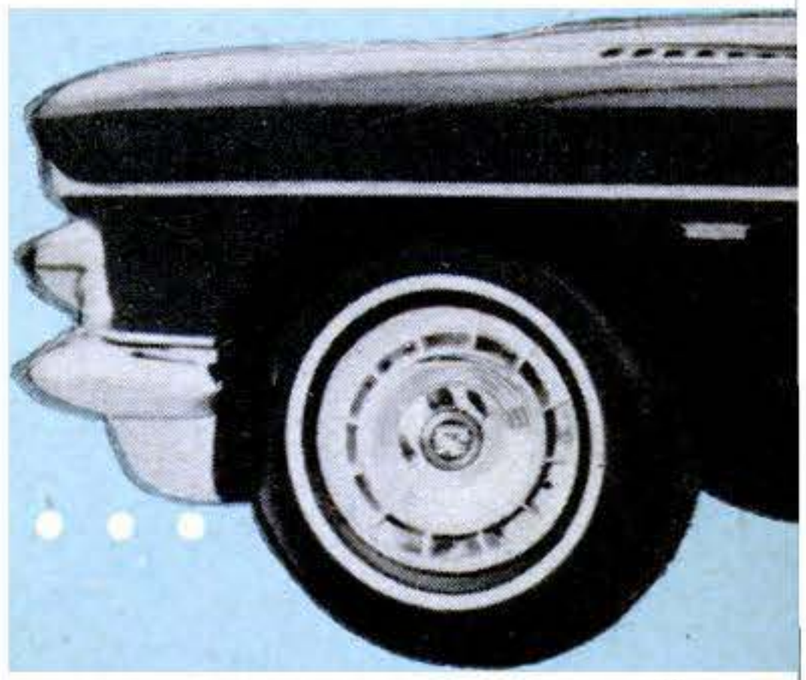
New Eldorado Brougham Is Loaded With Luxuries



BESIDES riding on revolutionary air springs (see page 126), Cadillac's all-new Eldorado Brougham features such other 1957 items as a gleaming roof of brushed stainless steel, safety door locks that operate electrically, ball-bearing door hinges, an automatic power-operated front seat, dual headlamps, a front-end-mounted air conditioner, and a 325-hp. power plant with twin four-barrel carbs.

Cadillac engineers and designers have gone all-out to put every last plush touch into the Eldorado Brougham, even to such curled-pinky details as a vanity fitted with perfume atomizers and built into the rear-seat fold-down armrest and a glove compartment equipped with tissue dispenser and cigarette box.

Ball-bearing hinges are another luxury touch. Open a door on the Brougham; it seems feather-light. What's more, you'll find no tall or bulky centerpost between the front and rear doors. The door locks are incorporated in a stubby centerpost that projects only a few feet up from the floor.

Climb into the front seat and your weight sets off a switch that operates the power-operated front seat to move it into your best driving position, which you've previously dialed in on a control panel mounted on the armrest. The controls allow you to dial for tilt either forward or backward as well as for up-and-down and fore-and-aft positions.

The front seat does another trick, too. Push a button on the left-hand side of the seat back, and the seat rolls forward to make it easier for rear-seat passengers to get in or out. Release the button and the seat returns to its original dialed-in position.

You'll find no battery under the car's front-hinged hood. It is stowed in a special recess in the Brougham's king-sized trunk. Another compartment carries two spare lamps for the dual headlights.

Combine these glamour features with the Brougham's new system of air suspension, a powerful engine, power braking and steering, and Cadillac's new tubular-center X frame, and you have Cadillac's answer to the new Lincoln Continental.

FOLD-DOWN ARMREST houses a complete vanity kit, including perfume atomizers. Grille above armrest is the rear-seat speaker for the radio.

A MASS OF MACHINERY—engine plus auxiliary items—is packed under the front-hinged hood of the Eldorado Brougham. What with space taken up by the air pump for the Brougham's air-suspension system, front-end-mounted air conditioner, and an assortment of power units, the battery has been shifted to a recess all its own in the car's big trunk compartment.

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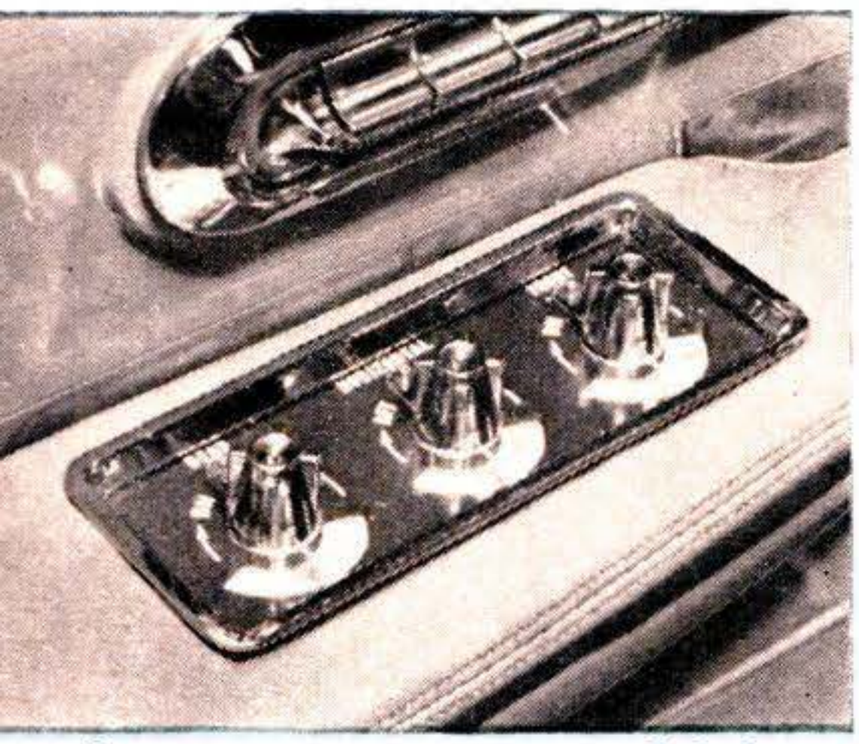
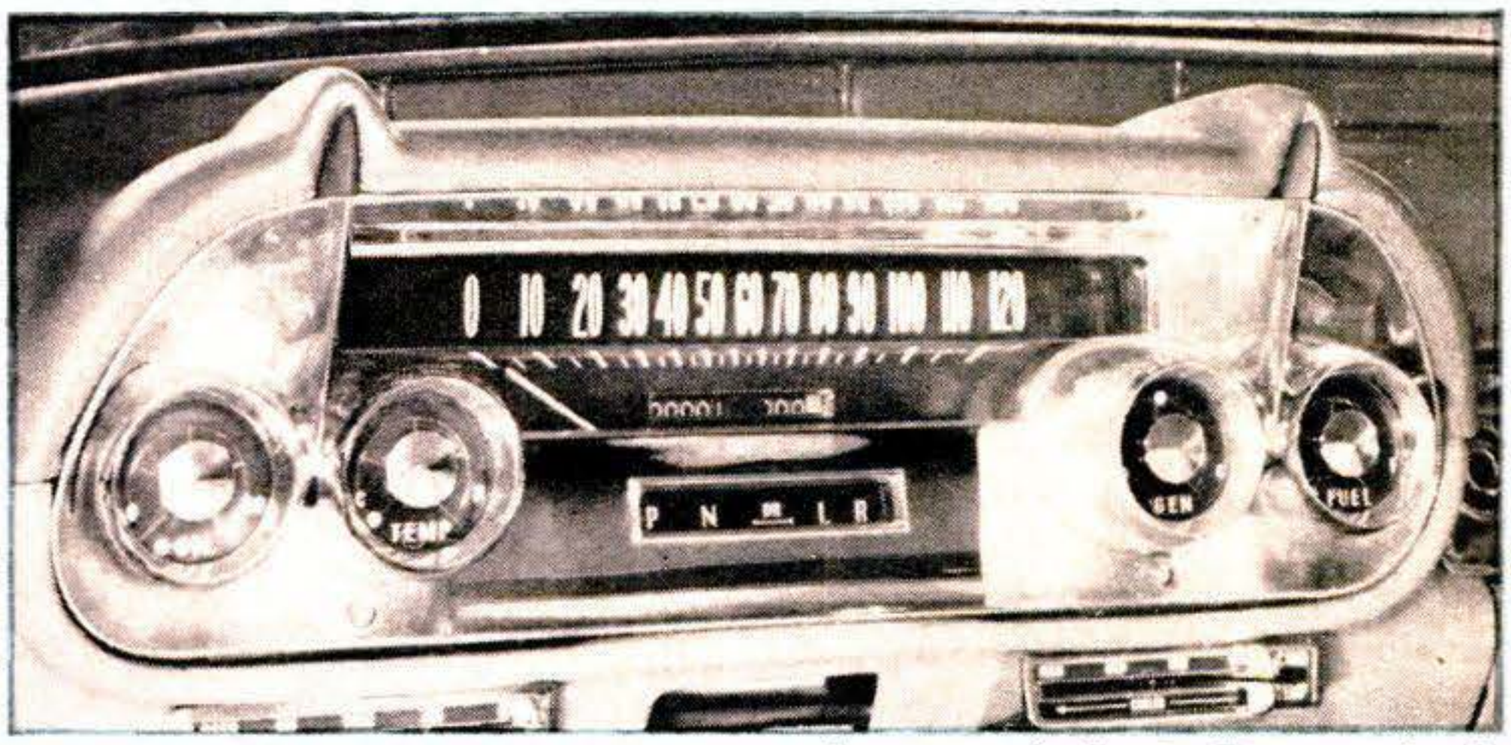
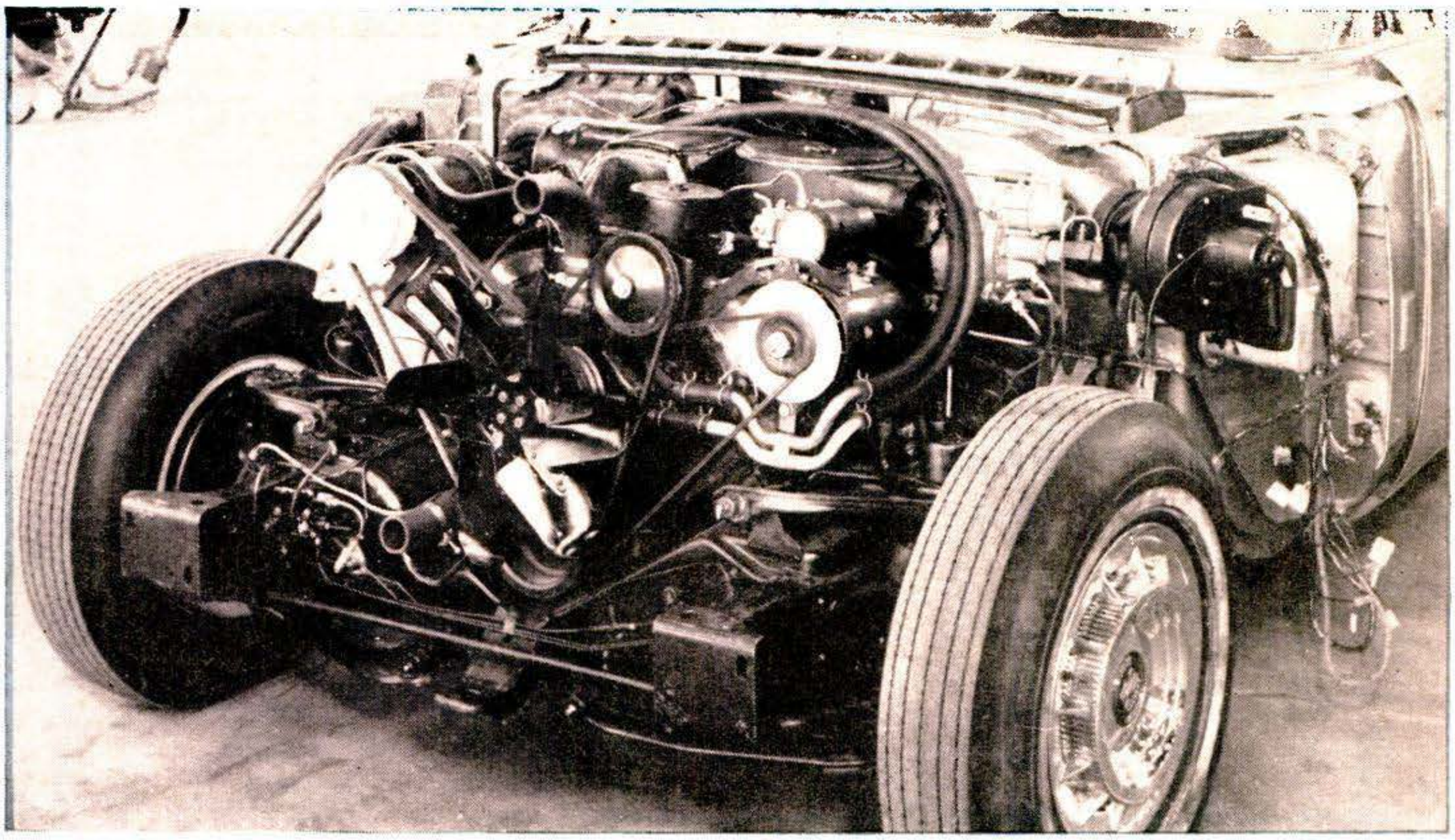
For the carriage trade: '57 Eldorado Brougham.



SET THESE DIALS on left-front door armrest and front seat will adjust itself to your dimensions every time you sit down. Buttons above dial operate windows.



FULLY PADDED INSTRUMENT PANEL has turn-light indicators built into design at the upper right- and left-hand corners. Among other refinements in the new Eldorado are electrically controlled door locks in the centerposts—neither rear door can be opened from the inside if the automatic transmission is in gear.



For more news of the Eldorado, please turn the page

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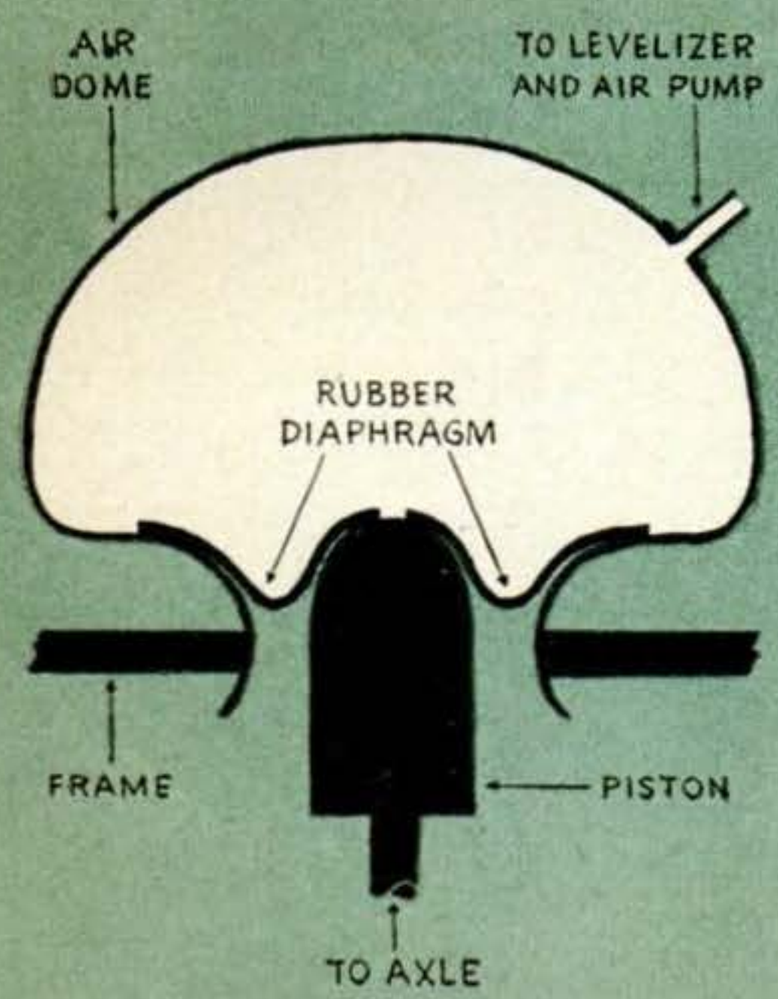
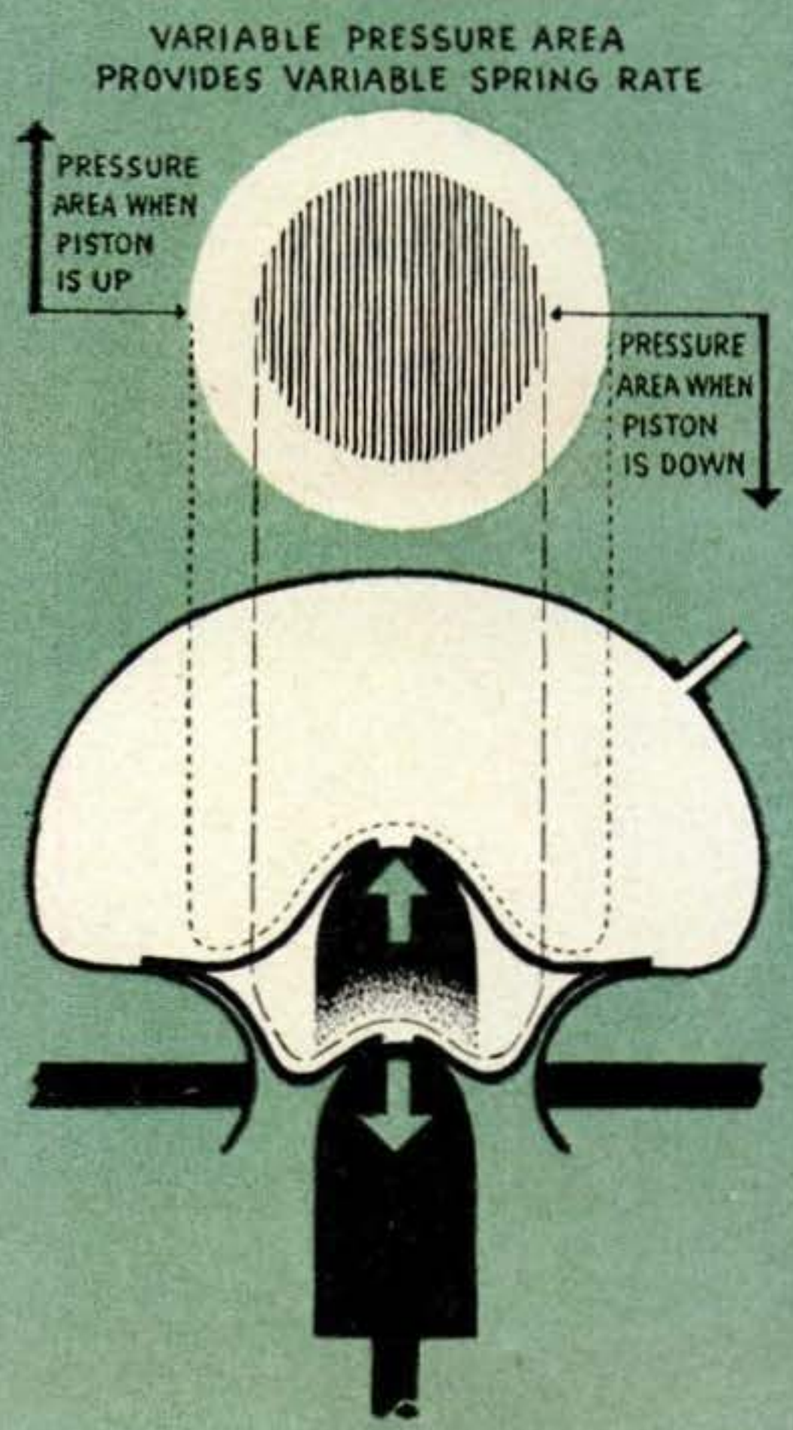
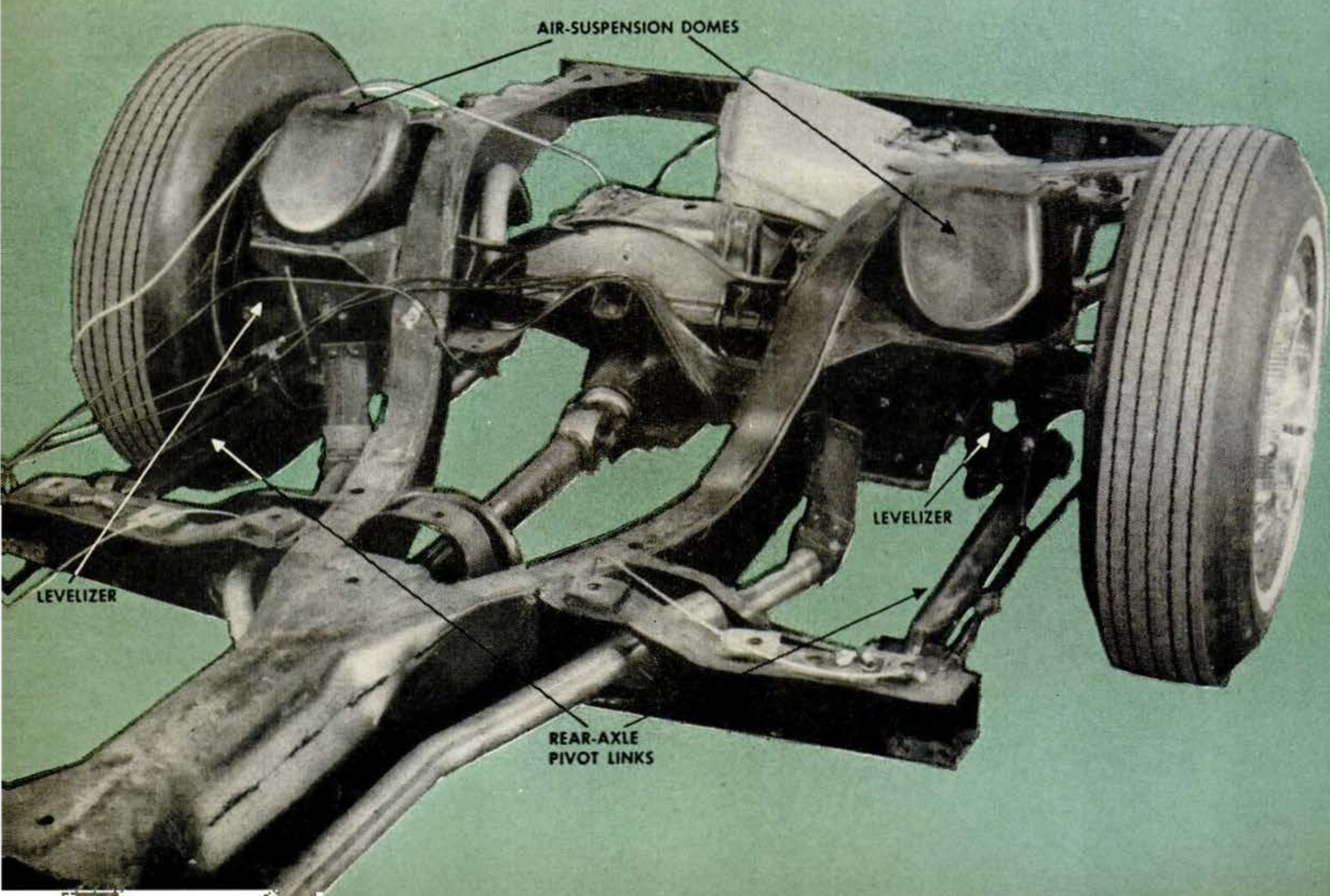
How it works: Eldorado's

Air-suspension domes create springs that adjust to load and road







New Air Suspension

Hit a bump or drop in a hole, travel light or load 'er down, the car's ride never varies.

By George H. Waltz Jr.

WHEN Cadillac lifted the wraps from its brand-new Eldorado Brougham at the recent New York Auto Show, an old advertising cliché—"it's like riding on air"—became a now-you-can-buy-it reality.

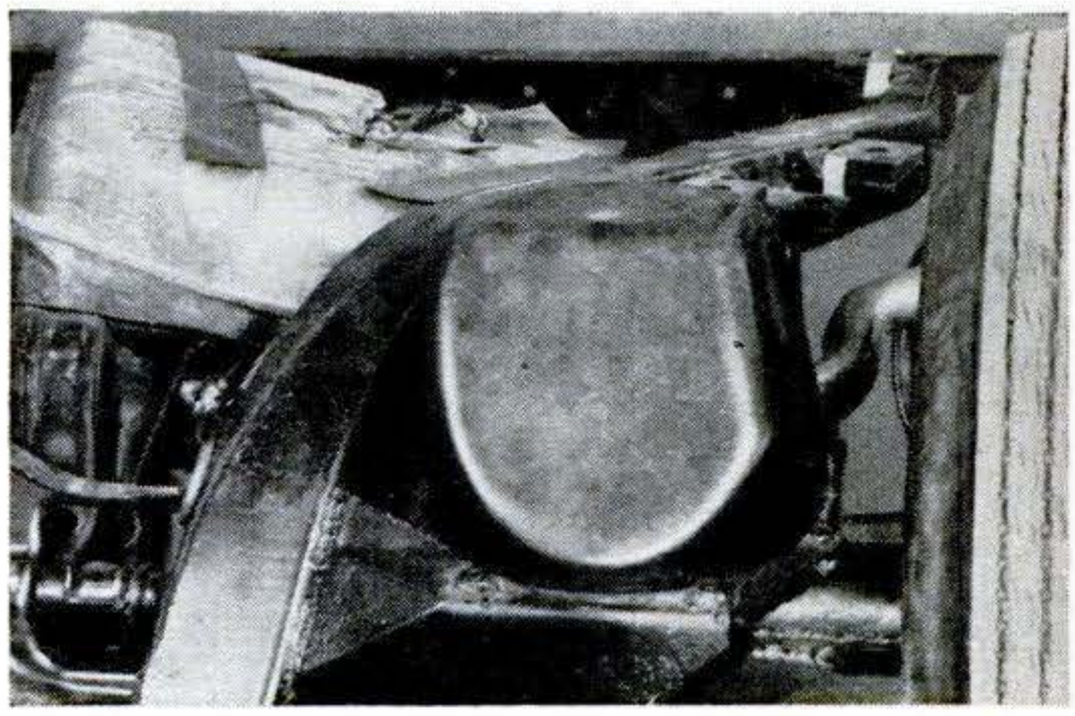
Cadillac's new Eldorado Brougham actually does ride on air, and that doesn't mean just the air in the tires. Equipped with the first true air-suspension system ever installed on a passenger automobile, the Brougham rides on unique air springs. (For a look at the new Brougham's many other features, see page 124.)

The springiness of air, in the Cadillac air-suspension system, has replaced the springiness of steel. On cars equipped with conventional metal springs, the car's overall height, and the overall effectiveness of the springs, is related directly to the total load. Pile more and more people into the car and the car settles down lower on the springs. This not only reduces the height of the car, but also reduces the springing action of the springs. Being depressed, they have less room in which to flex their metal muscles.

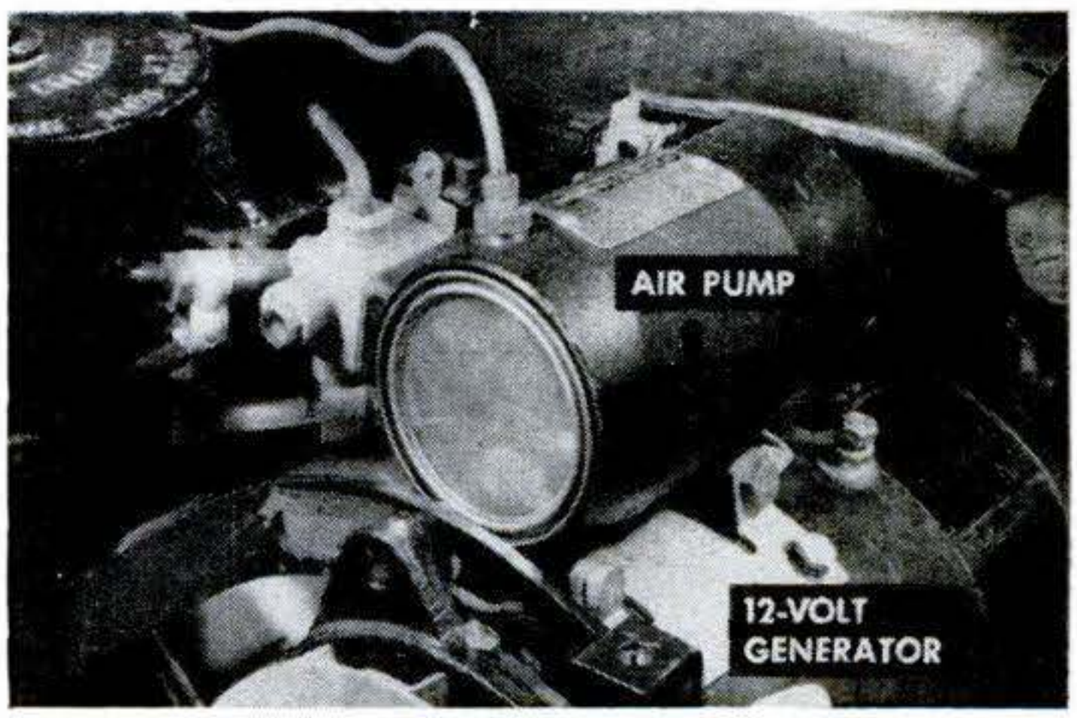
You've probably found that your car rides best when there are just yourself and one passenger aboard. That's just about the average load that the metal springs were designed for. Increase the load and springing tends to get mushier.

Cadillac's new system of air suspension was designed to eliminate all of this.

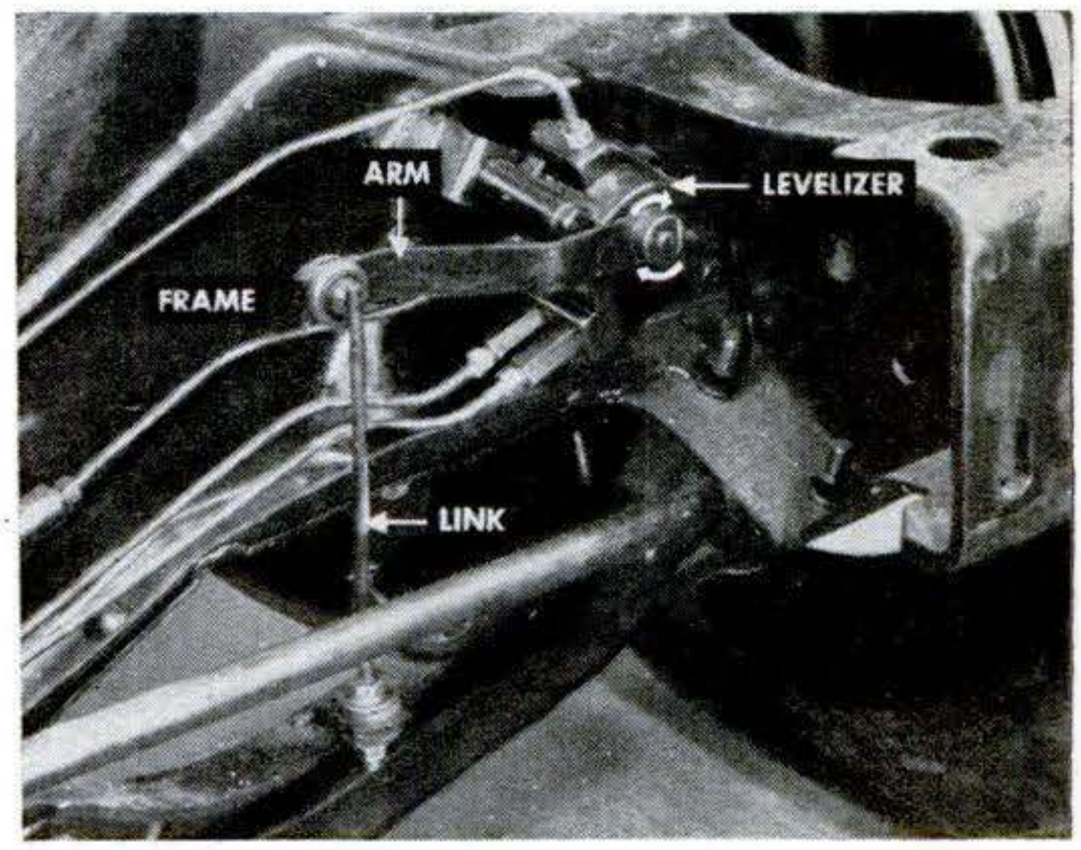
When the car is empty, pressure in the air system hovers around 80 pounds per square inch. As passengers and luggage enter, pressure goes up. In other words, the springing system reacts to maintain



AIR SPRING consisting of an air dome, rubber diaphragm and piston is mounted at each corner of the frame. The dome is fastened to the frame, the piston to the wheel support.



AIR PUMP mounted on top of the car's generator provides air for the air-suspension system. Its operation is automatically controlled by three levelizers and a master control.



THREE LEVELIZERS, two for the rear air springs and one for the two front air springs, control the flow of air to the springs. They react to changes in the car height, not weight.

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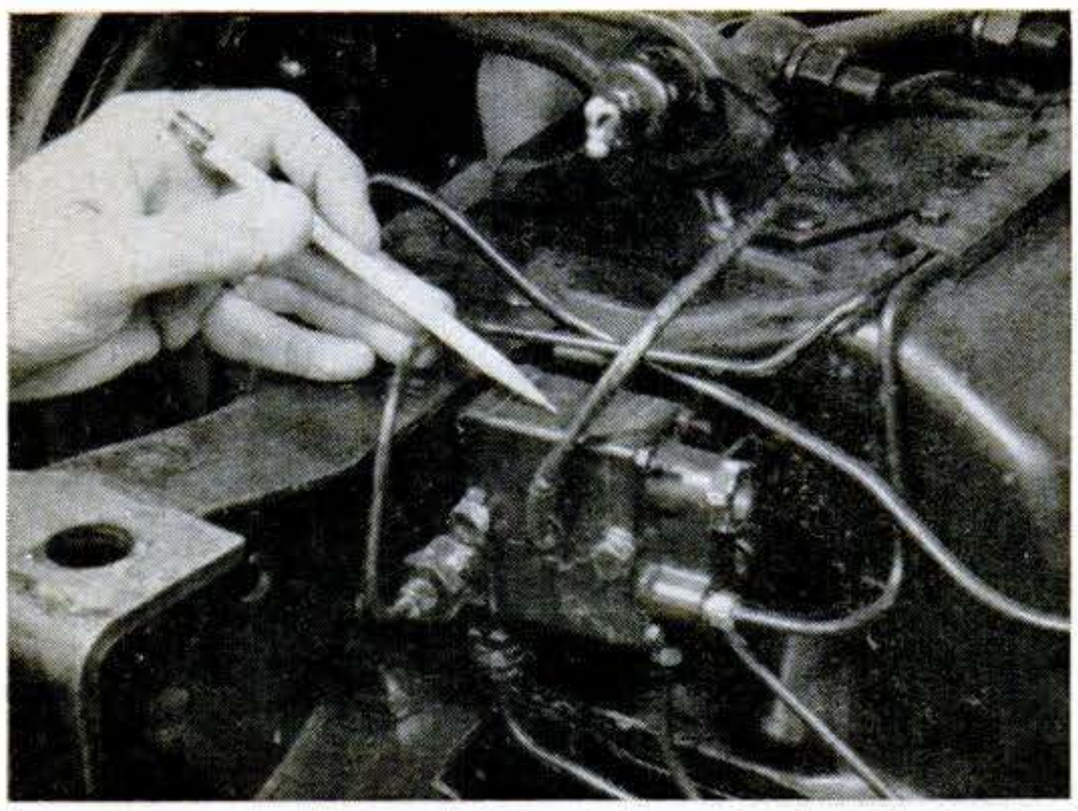

MASTER CONTROL TAKES OVER whenever a car door is opened, to compensate immediately for any change in overall car height caused by passengers getting in or out of the car.

car height regardless of load. It operates on the principle that air is a compressible, easily controlled medium. And it puts that principle to work to provide a variable spring whose action is altered automatically to meet moment-to-moment changes in road or load conditions.

How is this done?

Basically, the air-suspension system consists of four independent air domes, or modified air cylinders, which replace the conventional metal springs at the four corners of the car. Into each air dome fit a bulletlike piston and a tough rubber diaphragm (see diagram on page 126). The body of the air dome is fastened to the main frame of the car; the piston is fastened to the axle or wheel support. The air in the dome, acting on the rubber diaphragm, serves as the "spring" between the two. Air for the system is provided by an electric pump mounted on the car's 12-volt generator.

The system's "brains" consist of three levelizers: one for each of the two rear air springs, and one which, through a system of check valves, serves the two front-end air domes. These control the springing characteristics of each air spring by controlling the flow of air. Each levelizer consists of a mechanical valve, operated by an arm and a link that react to the relative up-and-down movements of the frame and the wheel support. It thus feeds air to each dome, as needed, to provide a level, bump-free ride. To make the response smooth, a time delay is built into the system.

Open any one of the car's four doors, however, and a master control takes over. An electrical interlock on the doors does the trick. This master control overrides the levelizers with their built-in time delay and monitors the flow of air into or out of the four air springs to compensate immediately for the slightest change in car height caused by someone getting in or out of the car. Close the car doors and the levelizers take over again. As a result, no matter how you load or unload the Eldorado Brougham, its roof is always just 55½ inches above the road.

The key to the system, however, is the design of the air dome with its rubber diaphragm and piston.

The rubber diaphragm provides a pressure area that is varied automatically. It provides, in effect, an expanding and contracting head for the piston, creating a larger pressure area (and therefore a greater downward pressure) when the piston is pushed up into the dome by a bump in the road, and a smaller area when the piston is moved down as the wheel sinks into a depression in the road.

Engineers anticipate no difficulties so far as the service life of the diaphragms is concerned. They expect these to last indefinitely.

As for the possibility of "leak-down" overnight, Cadillac says that the system will hold air pressure for several weeks without leakage. Even if it did leak down after a long period of disuse, it would not be disastrous—when the ignition switch was flipped the car would pump itself up off its haunches. END

NEXT MONTH: Annual Buyer's Guide to the New Cars Plus Color Photos of the 1957 Station Wagons.

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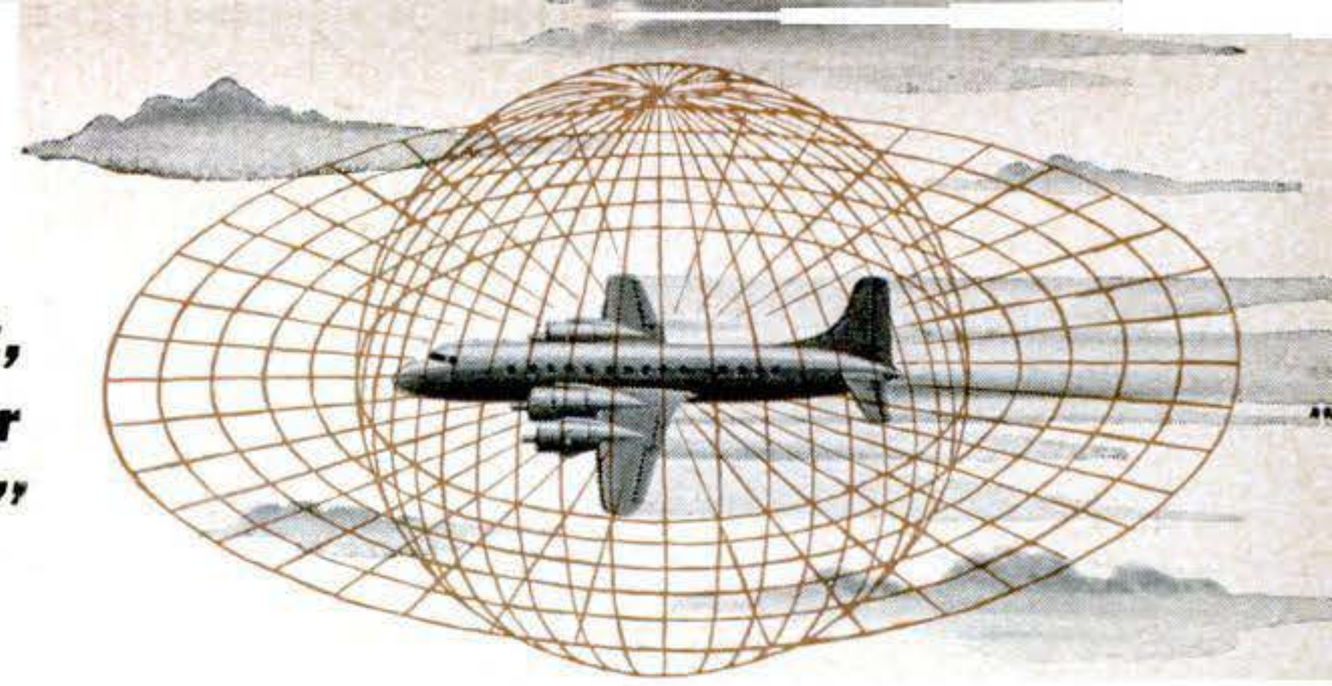


Flashing a warning to the pilot, a magic black box in an airliner will tell whenever an "intruder" flies perilously near.

Radar 'Bumpers' to Prevent Plane Collisions

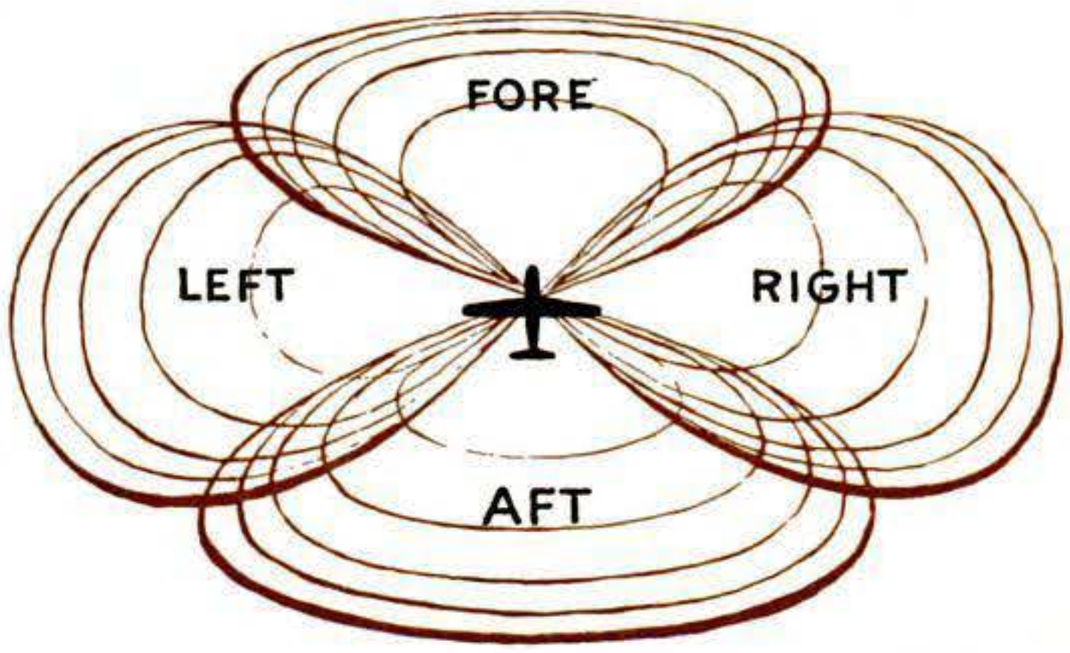
By Joseph Dorlaque

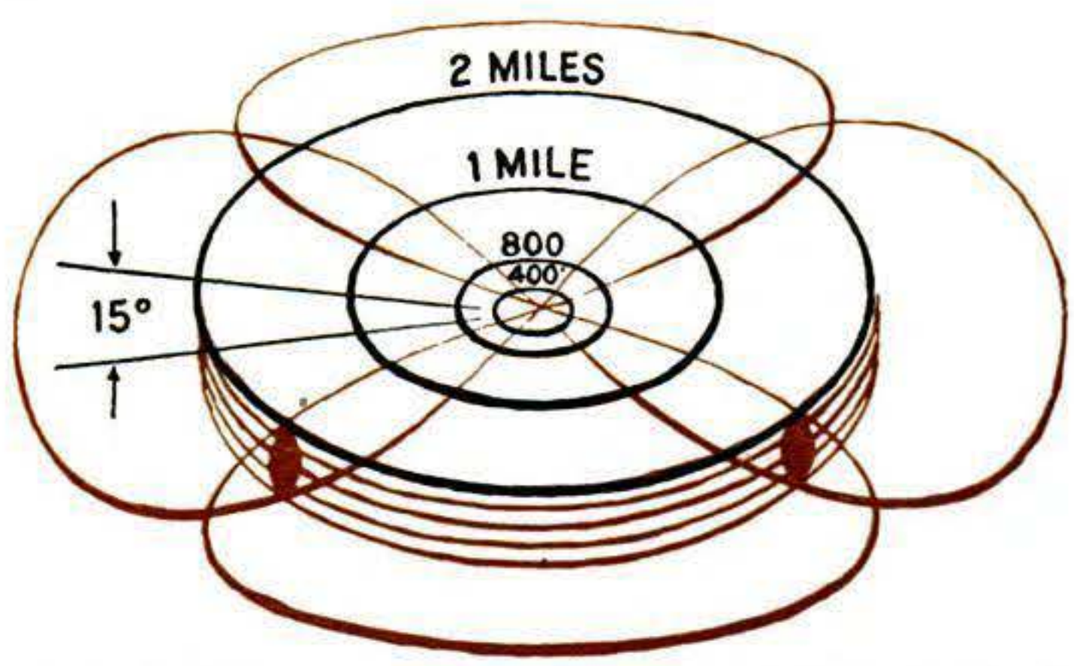
FOR sixty million years, bats have been using their own built-in "radar" to dodge trees, rocks and each other. As they fly they let out a series of ultrasonic screeches. Approaching an obstacle, the bats hear echoes in time to change course and escape a crash.

Now U. S. commercial airlines are about to catch up with the bats. In the works is a collision-warning system that they hope will make next to impossible mid-air crashes like the one that killed 128 persons last summer over the Grand Canyon.

Engineered by Collins Radio Co. of Cedar Rapids, Iowa, the crash-warning

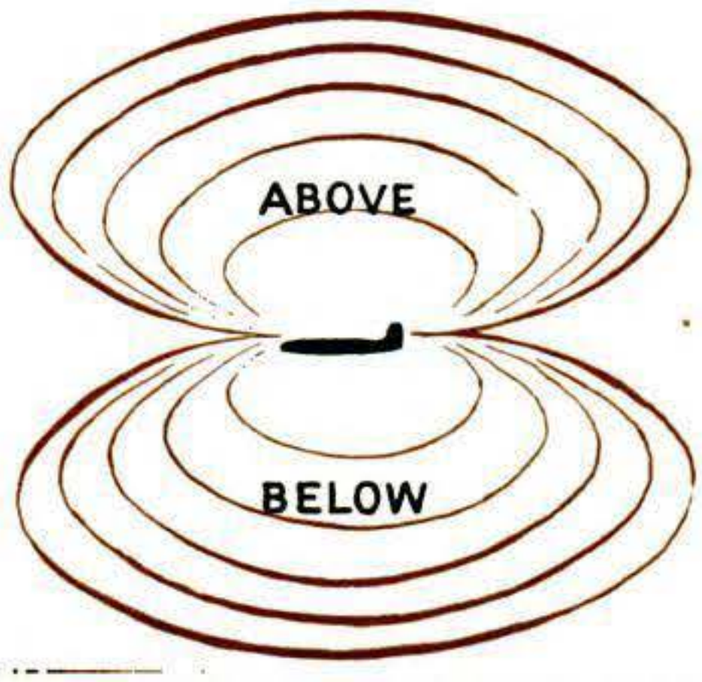
Radar patterns that will protect airliners

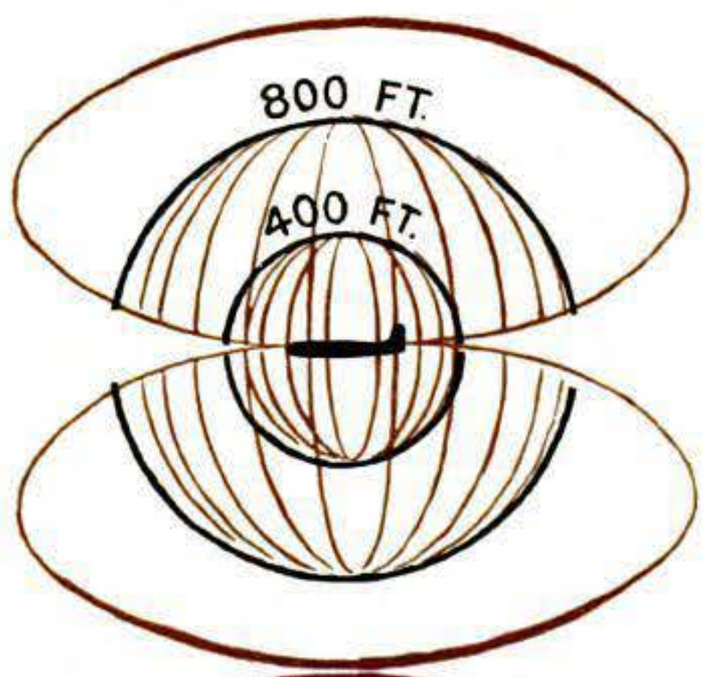




HORIZONTAL COVERAGE extends 360 degrees around and 15 degrees up and down. Filters chop the petal-shaped patterns into clean-edged circles, divided into two-mile, one-mile, 800-foot and 400-foot ranges. Each quadrant of the horizon is scanned every two seconds.

HEMISPHERIC COVERAGE is handled by separate antennas above and below. Patterns are chopped off in a ball shape with 800-foot and 400-foot ranges. To keep a plane from detecting its own tail or wingtips, a 200-foot minimum range is built into the crash-warning circuitry.





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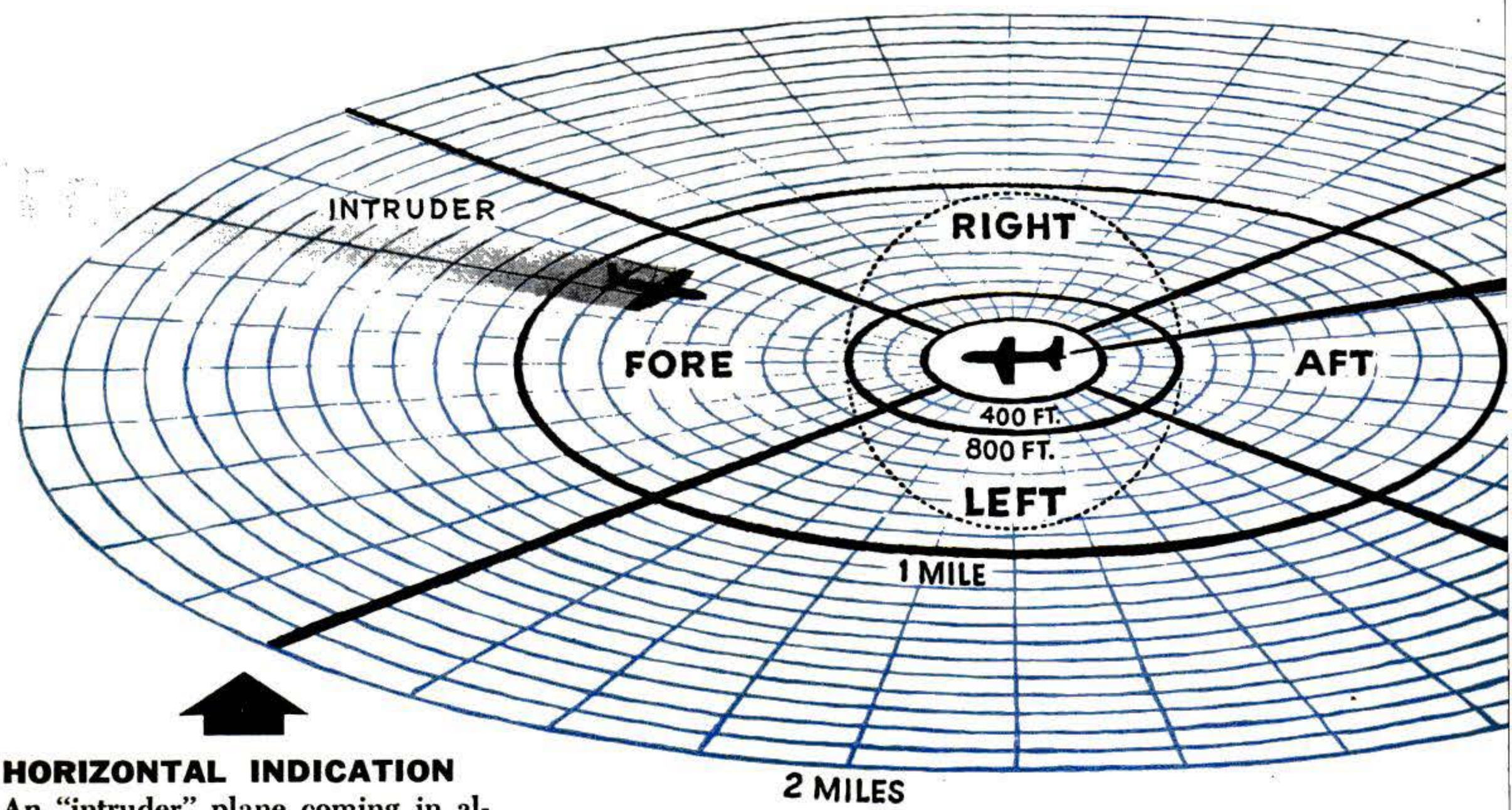
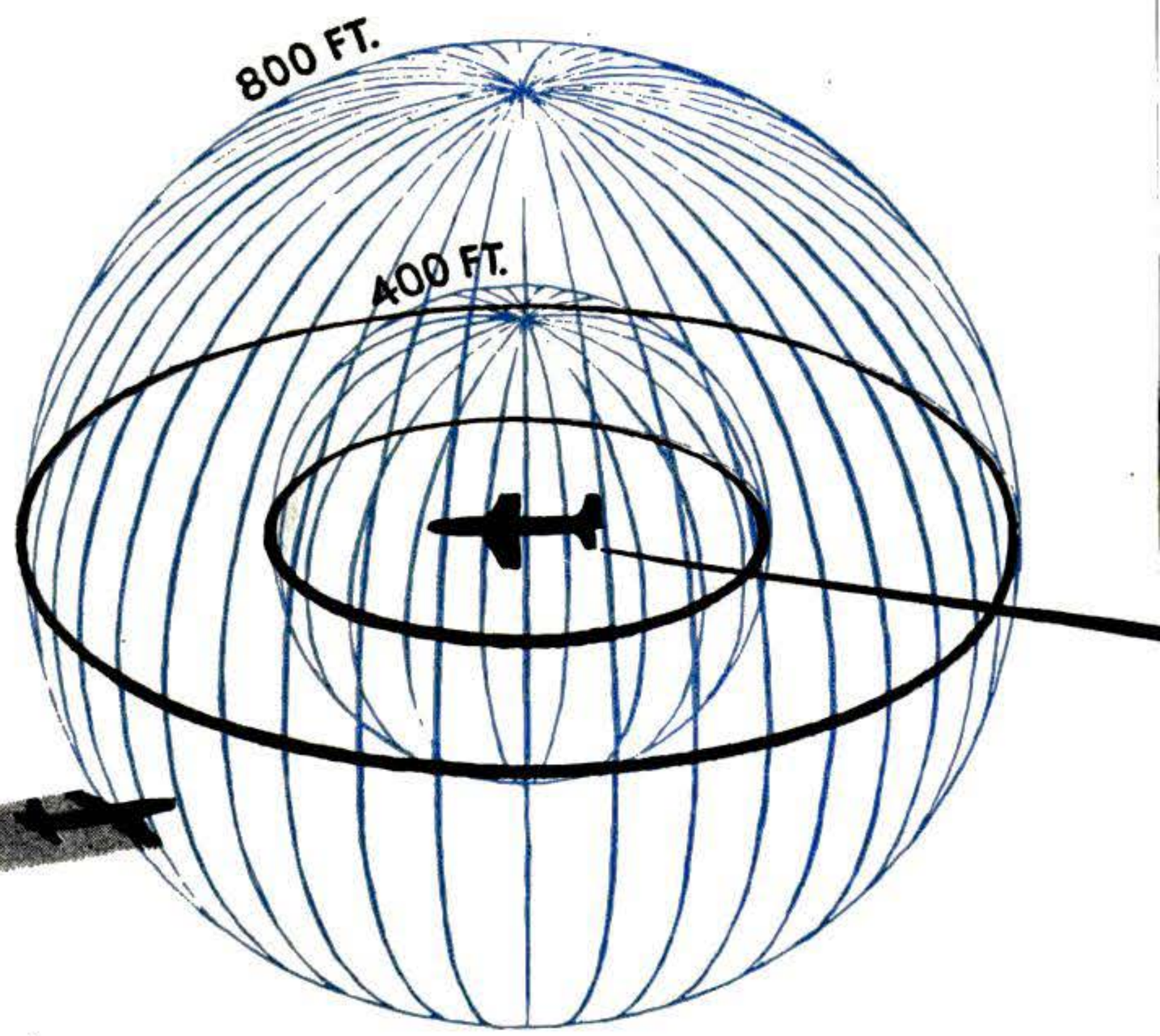


HORIZONTAL INDICATION
An "intruder" plane coming in almost head-on and in the one-mile range indicates its direction and distance by lighting up the proper lamp on a warning panel, shown at far right. Several intruders in different sectors and at different distances can be displayed.

HEMISPHERIC INDICATION
Coming in from below, this "intruder" lights up the 800-foot-below part of the indicator panel. If no evasive action is taken by either plane, the "below 400" will light up next. A warning sound to alert the pilot will probably be included in future versions of the system.



system will surround its airliner with a protective radar envelope. It will automatically alert the pilot whenever another aircraft comes within two miles at or near his altitude. It will also sound off if anything comes within 800 feet above or below his airplane. Signal lights on the instrument panel will show where the other plane is and about how far away it is.

Though the system is still mostly on paper, several major airlines already have placed orders for the gear. Collins expects to start flight-testing the equipment by January, 1958, and to begin turning out the 70-pound sets late that year. Collins engineers are also dreaming up an advanced version, further in the future, with a computer that will decide whether a crash is coming, speedily solve some problems in solid geometry, and then tell the pilot which way to turn to

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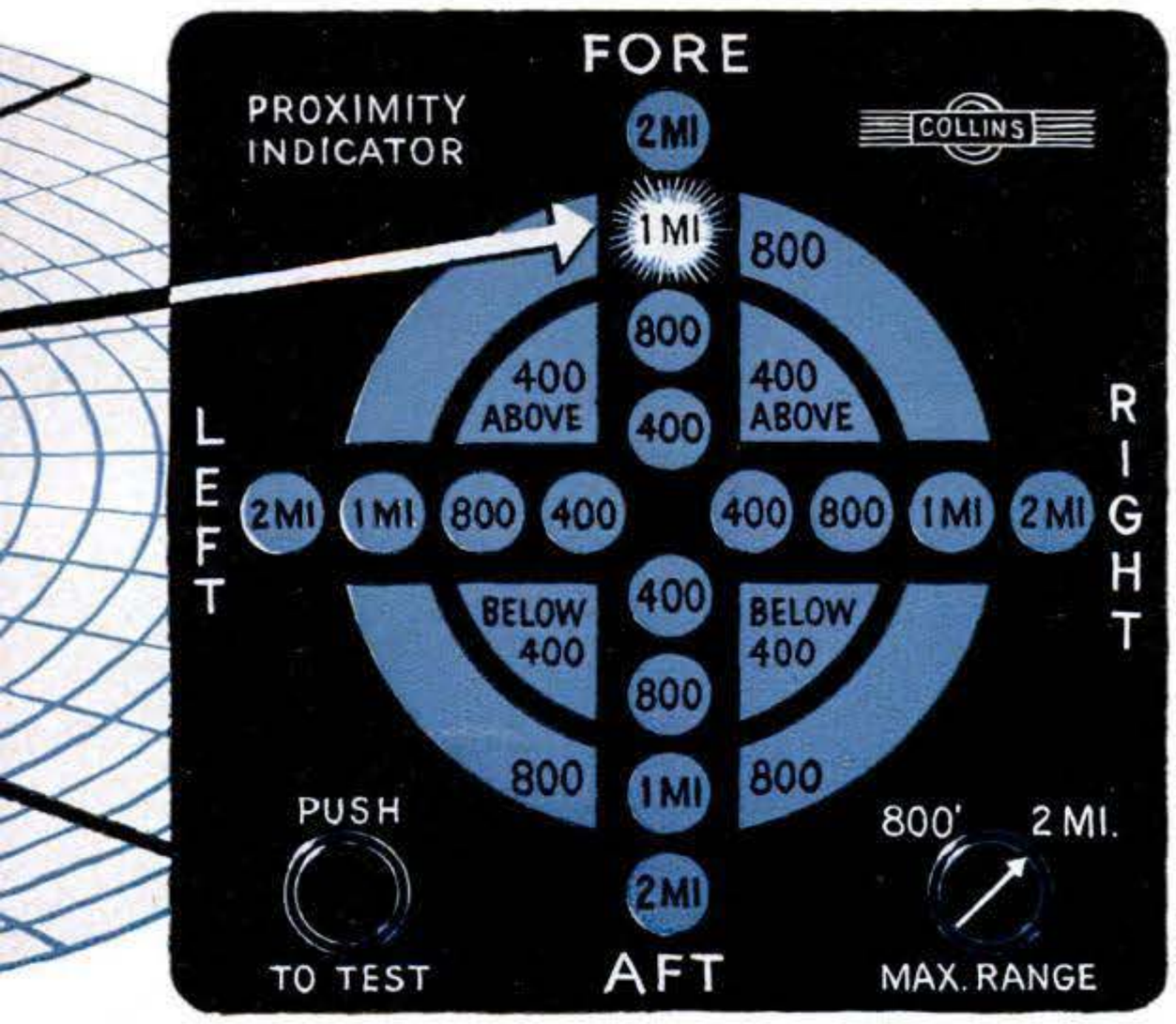

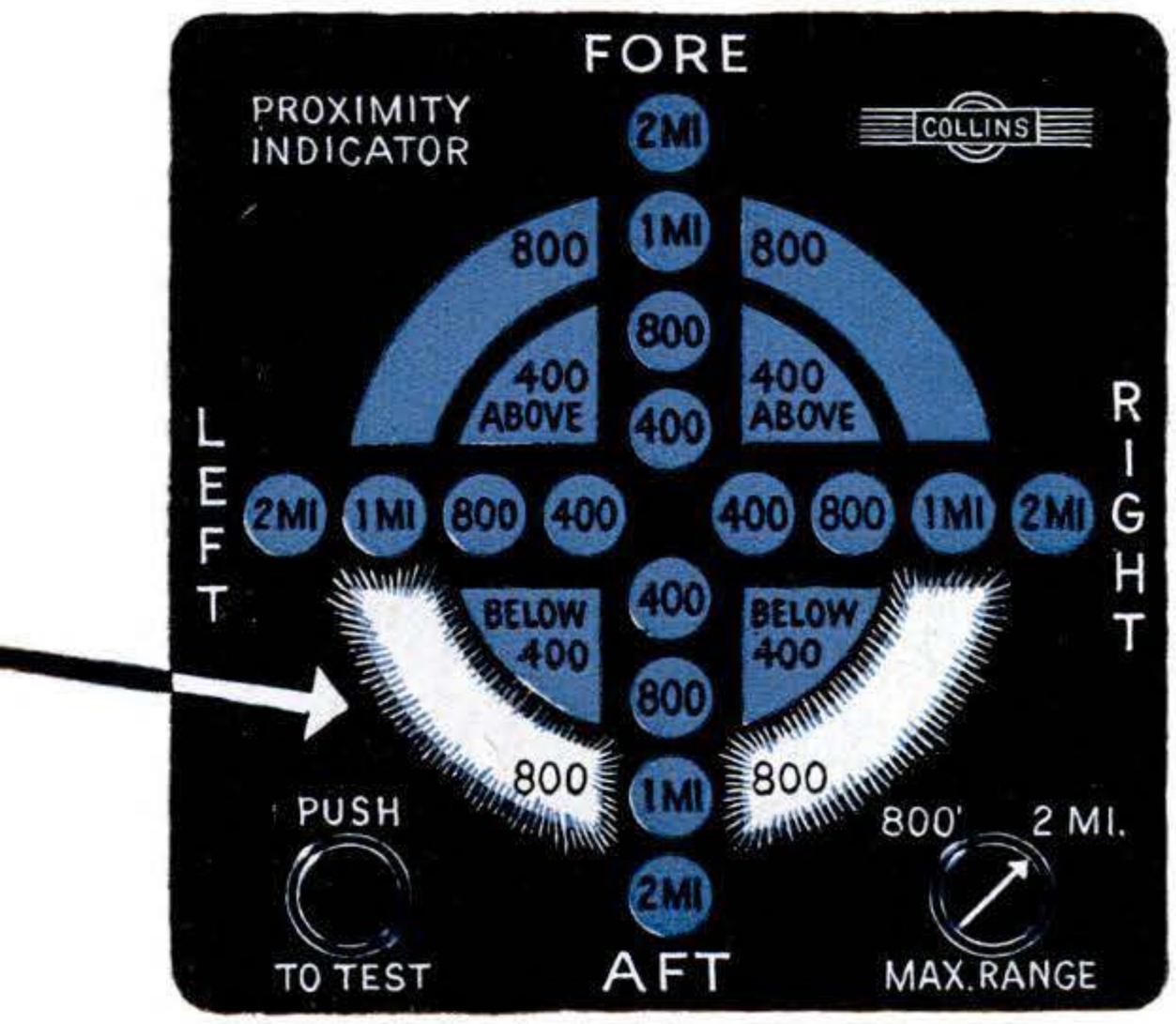

escape disaster. The ultimate step, of course, is to feed computer commands directly to the automatic pilot, so that evasive action is taken automatically.

The danger of mid-air collision is very real. Airline pilots aren't as blind as bats, but the cockpit of an airliner is no crow's-nest of visibility, either. Even in the clearest skies, pilots can see only out front, somewhat to the sides, and a little above. They can't see below or behind. Two airplanes can fly close together for a long time without either pilot realizing it.

All those gleaming dials and needles on his instrument panel tell the pilot a lot, but at present none tells him the one thing he sometimes needs most to know: Where are the other guys?

This question becomes more and more critical as air traffic steadily increases, and jet-age air speeds climb constantly higher. Collision dangers are not restricted to congested areas like New York, Chicago and Los Angeles; they are also a real peril on the heavily traveled airways between.

The Air Transport Association, an organization of the major airlines, made a survey in 1955 and found to its alarm that on the average day there are four near-collisions involving airliners.

The Civil Aeronautics Board reports that between 1948 and 1956 there were 127 mid-air crashes involving commercial, private and military aircraft. The CAB report said that the "outstanding probable cause" of the 127 accidents was failure to see the other fellow.

The radar now carried on some airliners is designed only to help a pilot avoid bad weather, or to measure distance above the ground. Eighteen months ago the ATA asked electronics manufacturers to develop a collision alarm and automatic avoidance mechanism. Some manufacturers said it couldn't be done. Ten of them did come up with something. The ATA liked the Collins ideas the most.

Collins expects its system to be sensitive enough to spot a small jet fighter two miles off and coming head-on. As it comes nearer, different lamps on the instrument panel would light to show the change. Also, any "creeper" that drifts too near from above or below will be announced by other lamps.

If a lamp lighted up when the weather was clear, the pilot would look around, try to spot the "intruder," and decide whether any action would be necessary to avoid a collision. If he were flying on instruments, in bad weather, he would

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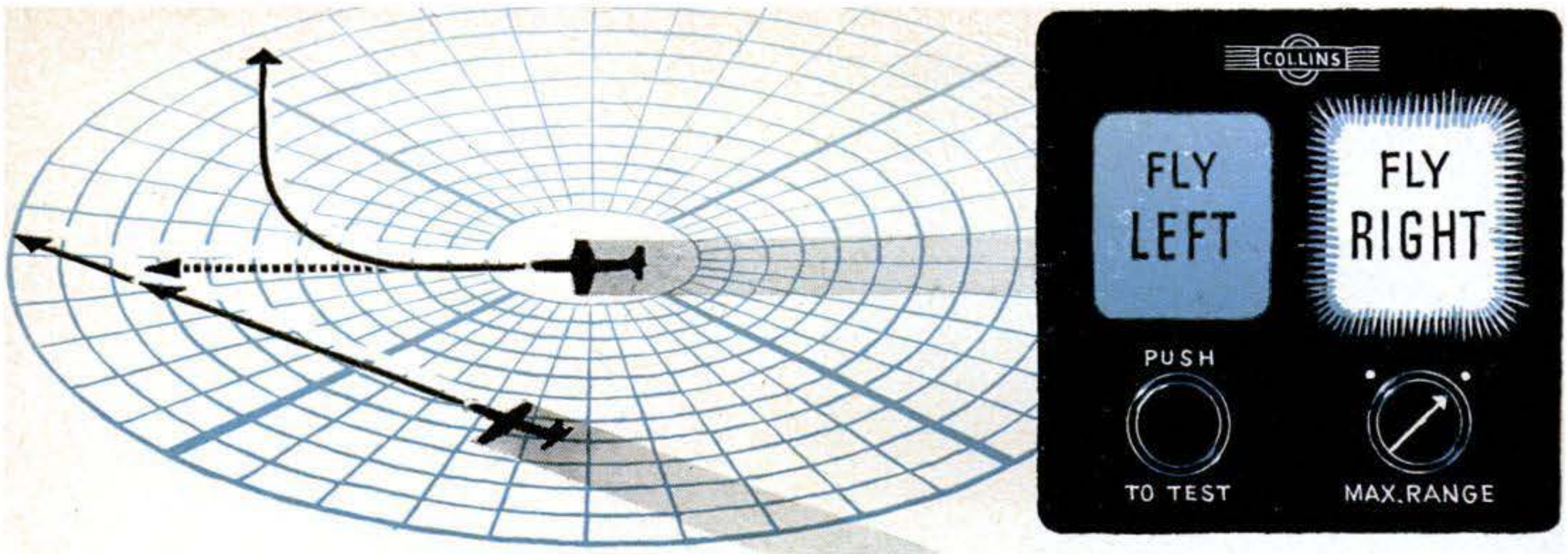

TELLING THE PILOT how to avoid a mid-air collision would be done by future models of the device. If both planes above, flying at the same altitude and speed, continued on their courses, they would crash. With the addition of a computer to figure closing rates, the indicator panel —shown in an artist's conception above—could display the correct evasive maneuver.

have to make his decision on the basis of the distance and direction information shown on his indicator panel.

The system will use continuous-wave FM radar beams instead of pulse radar. The reason is that pulse radar must switch continually from "transmit" to "receive." Since the new device will have to operate at ranges down to 200 feet, the pulse echoes would come back too quickly to allow switching.

The proximity-warning equipment will operate like an FM radio altimeter. With frequency modulation, a signal goes out on one frequency. By the time it strikes an object and bounces back, another signal on another frequency is being sent out. The difference between transmitted and received frequencies is thus a measurement of the distance to the target.

Six flush-mounted non-rotating antennas will be used. Two will be for continuous, hemispherical search above and below the plane, out to a maximum range of 800 feet. This limit has been set so that passing airliners flying at assigned 1,000-foot altitude separations will not trigger an unnecessary alarm.

The other four antennas will be for 360-degree search at the same altitude as the protected plane, and 7½ degrees above and below, out to a distance of two miles. Each of the antennas, covering fore, aft, left and right sectors, will be energized by a common 100-watt transmitter and connected to a receiver every half second. Thus the entire 360-degree horizon will be covered every two seconds. Close in toward air terminals, where heavy traffic might bring too many warnings, a pilot can flip a switch that cuts the maximum range to 800 feet.

A feature of the antennas is that the transmitted and received signals will vibrate in different planes, 90 degrees to each other. This is called cross-plane polarization. Aside from isolating the two signals, this will filter out echoes from rain clutter and help to prevent interference from warning equipment in other airliners.

Later models of the warning equipment will provide a pilot with what-to-do information. The system will follow the situation, decide when a collision becomes a real hazard, and then tell the pilot what escape maneuver to execute. To do this, the device must figure not only distance and direction, but the courses and closing rate between two airliners. An electronic computer will solve this continuous geometric problem.

The chance that airplanes may crash head-on is relatively small. Usually they approach each other at an angle, over a long distance, from above, below or the side. The Collins system, however, is being designed for all situations, including a head-on crash. The closing speed between today's airliners could be 800

[Continued on page 238]

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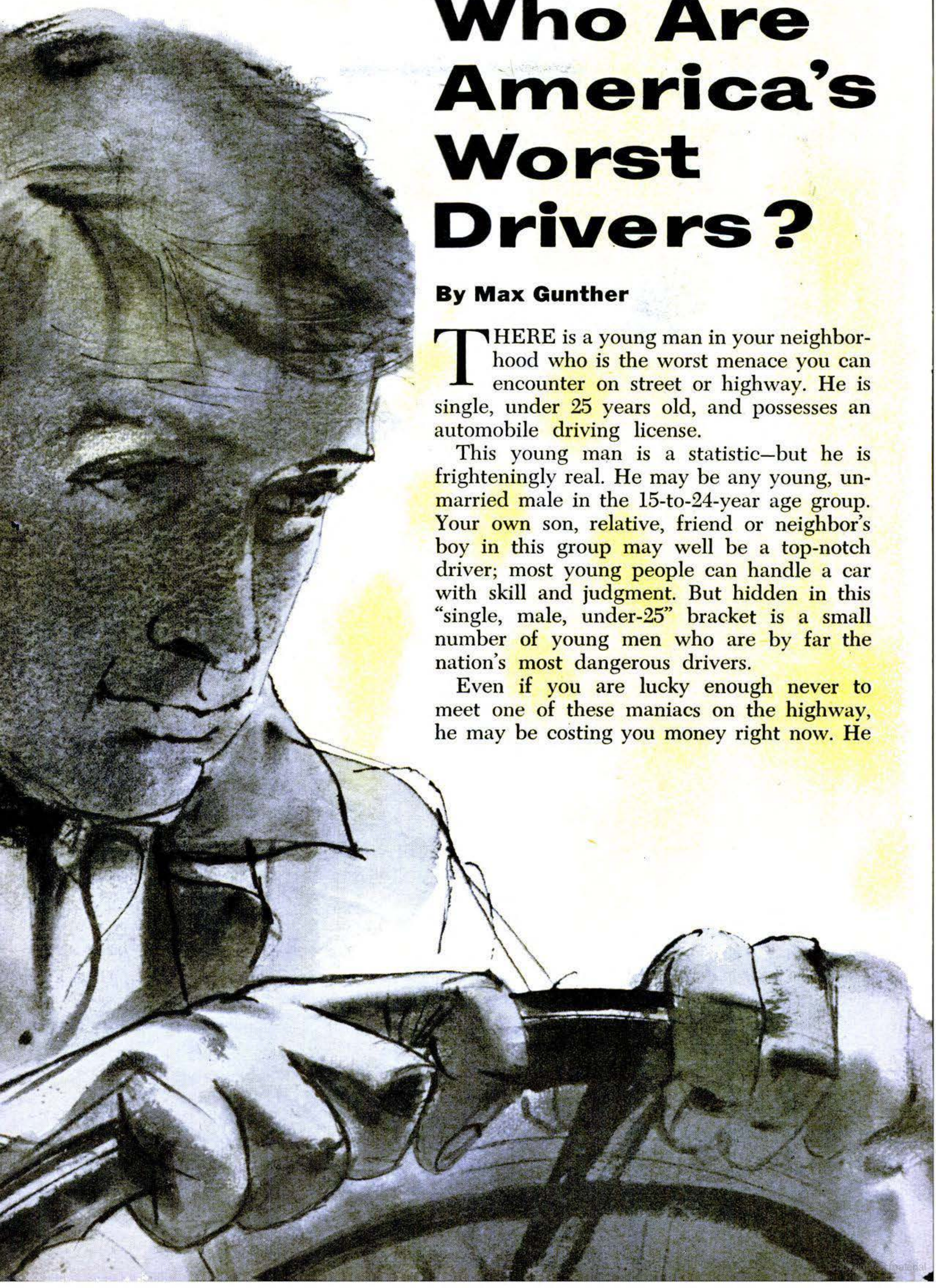

Who Are America's Worst Drivers?

By Max Gunther

THERE is a young man in your neighborhood who is the worst menace you can encounter on street or highway. He is single, under 25 years old, and possesses an automobile driving license.

This young man is a statistic—but he is frighteningly real. He may be any young, unmarried male in the 15-to-24-year age group. Your own son, relative, friend or neighbor's boy in this group may well be a top-notch driver; most young people can handle a car with skill and judgment. But hidden in this "single, male, under-25" bracket is a small number of young men who are by far the nation's most dangerous drivers.

Even if you are lucky enough never to meet one of these maniacs on the highway, he may be costing you money right now. He

Only 15% of U.S. drivers are under 25 years old . . .

Source: Driving Research Laboratory, Iowa State College

. . . but this group is involved in 27% of fatal accidents

Source: The National Safety Council

certainly is if you have a son—or are yourself—in that bracket, no matter how careful a driver.

The following announcement, for a Southern state, by the National Bureau of Casualty Underwriters, is typical of the rate-change notices on automobile-liability insurance that they have been sending out practically every month lately, affecting one state after another.

"Cars owned or principally operated by unmarried young men under age 25 are classified as the most hazardous class of private passenger-car risks. The rates for these cars are increased, and the increases range [for the 'basic limits' policy: $5,000, $10,000 and $5,000] from $16 to $54, according to territory."

Insurance companies don't set their rates by crystal balls; they reach deep into statistics and come up with cold facts. The evidence against the wild young driver is shattering—and if you know many young people, the likelihood that one of them is a potential highway killer is distressingly real. This small percentage has swelled the accident record for their entire group alarmingly.

In Minnesota, drivers aged 15 to 24 had 214 fatal accidents in 1955. This compares with 152 for the 25-to-34 group, 103 for the 35-to-44 group.

In Arizona, the Traffic Safety Division reports that the 15-to-24 age group drives only one-half to one-third as many miles as the 25-to-34 group. But the younger drivers have more accidents: in 1955, 8,131 as against 7,574.

In New York, a 1952 survey showed that 12% of all licensed operators in the state were under 25. But they piled up 21% of all the fatal accidents that year.

You may pay more for insurance next year, if your son is in the single-under-25 category or you are in it yourself. The record is so bad that many insurance companies see small profit even in the present high premiums for young male drivers. Says one insurance executive: "You can't refuse a man insurance just because he's single and under 25, but we'd sure like to."

In most regions, a car owned or principally operated by a young man takes an insurance rate at least double that of a family car driven by older folk. The National Bureau of Casualty Underwriters is campaigning to boost this to triple the older drivers' rate.

Why is this group considered the most hazardous insurance risk? Why must a young bachelor pay more than a married man the same age?

Rate makers feel that marriage tends to calm a man down. A new husband is likely to have a growing sense of responsibility, especially if he has or expects children. His wife will probably take a proprietary interest in him, even to the extent of reining him in if he forgets his new status.

Why aren't girls of this group in the same class? For one thing, they drive less than men. Also, there are a lot fewer females in this age bracket at the wheel. According to a recent study in Akron,

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Connecticut Governor Comments on This Article

Unless the present trend is checked, motor-vehicle accidents will cause half a million deaths in the U. S. in the next decade.

Frank articles such as that being carried by POPULAR SCIENCE *this month will bring about an awareness of the highway safety problem.*

We must impress on parents and young people the fact that drivers under 25 have the highest accident rate.

Our young people must be trained in safety, and this training must start in the home. Secondary schools, through driver-training courses, can play a major role in formulating good driving habits. Teen-agers who have had driver training compile far better records than those who have not. If every secondary school in the country offered a driver-training course—and if all parents emphasized the need for proper driving—we would be going a long way towards developing responsible drivers for the future.

—THE HON. ABRAHAM RIBICOFF, GOVERNOR OF CONNECTICUT
Chairman of Traffic Safety Committee, National Governors' Conference

Ohio, by the American Automobile Association, 30 out of 100 drivers under 25 are female. But they account for only nine percent of the accidents.

The National Safety Council and most psychiatrists agree that the chief reasons for the young male driver's record are psychological. "Reminds me of a horse-trading story," says Prof. A. R. Lauer of Iowa State College's Driving Research Laboratory. "A buyer brought a horse back, complaining that he was blind and walked into trees. 'He's not blind,' insisted the seller. 'It's just that he doesn't give a darn.'"

It's normal for a young man to be more venturesome than his sister. Sports and the necessity of making a living put a premium on a certain amount of male competitiveness and aggressiveness. Says Herbert J. Stack of New York University's Center for Safety, "A boy wants to run faster or hit harder than the next. A girl wants to be more beautiful or dance more gracefully."

Once behind the wheel, a teen-to-24 driver feels an urge to show off his skill and daring, Dr. Lauer's work indicates. This urge seems to be strongest when the car is full of passengers. Police say that some of the most dangerous cars on the road are those packed with young people. "When they start horsing around," says a New Jersey official, "the same boisterous behavior begins to show up in the driving."

The percentage of accidents in the

[Continued on page 236]

Portrait of a Problem Driver

Young drivers who are accident-prone often share certain telltale characteristics that portend trouble, according to Prof. A. R. Lauer, director of the Driving Research Laboratory, Iowa State College.

These are only warning signs, of course, but group studies indicate that the youthful problem driver may exhibit one or more of the following behavior patterns:

1. *He is resentful of authority, doesn't like to take orders from anyone—at home, at school or on the job.*
2. *He is a poor sport—won't follow the rules of the game.*
3. *He is an exhibitionist—watch out for squirrel tails!*
4. *He is irresponsible, undependable—flits from one job or task to another.*
5. *He is likely to be on the aelinquent side. There is a close parallel between the ages at which youths get into trouble generally, and when they commit traffic violations.*
6. *At the wheel, he is given to speeding, tailgating, unnecessary passing.*
7. *He is overconfident about his driving—thinks he is more skillful than he actually is.*

Riding the Santa Fe's Split-Level Train

TWO FEET TALLER than the conventional train it's passing here, the "hi-level" El Capitan seats its passengers way up—four feet, three inches higher over the rails than most other trains.

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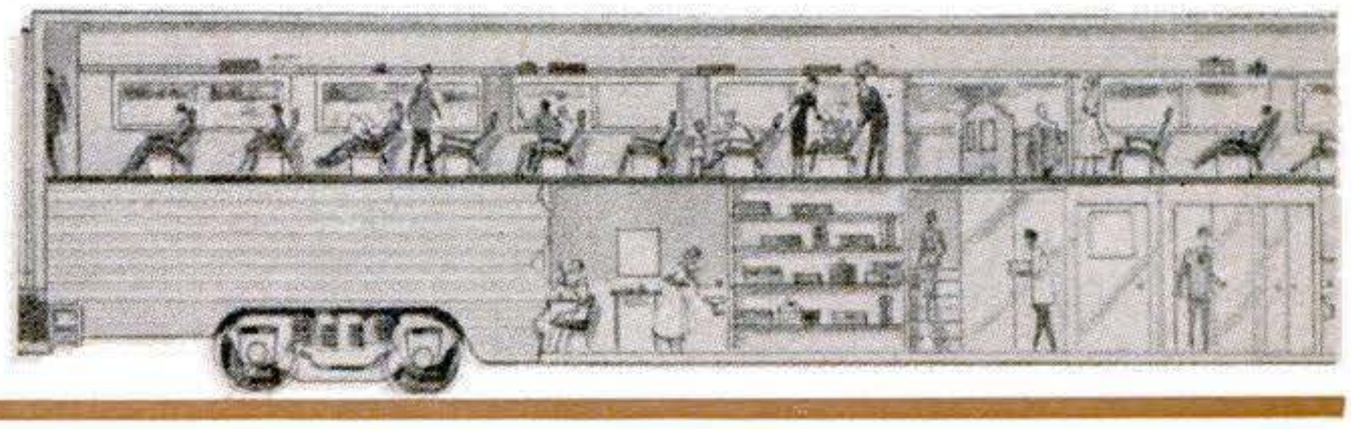
PS reporter rides "upstairs" in the new El Capitan to see how ▶

By Wesley S. Griswold



This is the second of two POPULAR SCIENCE *reports on the new coach trains with which the railroads are battling to hold passenger traffic against the competition of airlines and buses. The first, last month, described New York Central's light, low-level Xplorer. In contrast, Santa Fe's new El Capitan—described here—uses the highest, heaviest and most expensive cars ever built for coach-train service.*

"THIS is the way to travel," said the man from Massachusetts, who lay nearly flat on his back on a train seat that could be tilted more ways than a Link Trainer. Hitching on one elbow, he waved his cigar at the bold expanse of Mojave Desert gliding soundlessly by 10 feet below us.

"You can have your rail-hugging trains of tomorrow," he expanded. "I'll take this high-level Santa Fe job. It's as good as flying, without the noise."

The man from Massachusetts was being swept off his feet by his first ride in a $2,400,000 penthouse train—the Santa Fe's newly re-equipped Chicago-Los Angeles flyer, El Capitan.

As a fellow El Capitan rider, I shared his enthusiasm for the most luxurious all-coach mainliner on the rails today. I, too, had sampled Aero-Trains, Talgos and Train X's; low-slung, low-cost featherweights that are much touted these days as the only answer to ever-mounting passenger-train losses.

Yet here was the new El Capitan, looking down from its skyscraper height of 15½ feet (that's two feet higher than a conventional coach and almost 5½ feet higher than some new underslung trains) and chuckling softly at the lightweight competition.

The El Capitan coach I was riding in from Los Angeles to Barstow, Calif., was

"SKY LOUNGE" offers almost as full a view as a dome car; Kochina room, below it, has picture windows. Lighting here is indirect fluorescent; slotted paneling delivers warm or cool air.

ONE SHORT STEP puts this passenger on the lower level of an El Capitan coach. Its outside height is 15½ feet, just clearing the roof over the loading platform at the Los Angeles terminal.

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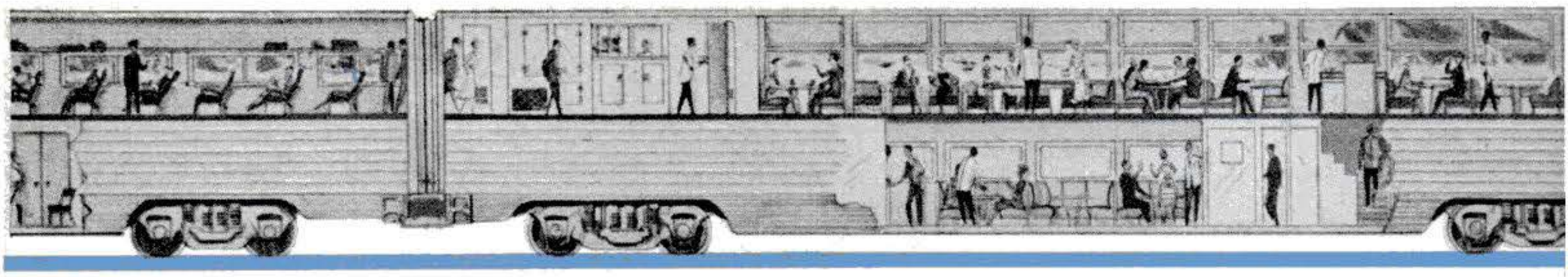
the double-decker cars work. The lounge car seats 86 on two levels,



unbelievably elegant and spacious. It weighed a third again as much as its standard-weight predecessor on this run, and from four to five times as much as a low-center-of-gravity car. It had cost the Sante Fe more than $1.60 a pound. That's only 40 cents less than the going per-pound price of America's most expensive automobile, the Mark II Continental.

Had the usually smart Santa Fe gone off its handcar rocker by offering this de luxe deal to the lowly coach traveler?

When I put the question to the Santa official who had been assigned to fill me in on facts and figures on the trip, he bristled with indignation.

"Coach travelers aren't lowly on the Santa Fe," he said. "They're the lifeblood of this or any other railroad's passenger business."

"Sorry," I mumbled, and his manner softened.

"Nevertheless, I'll admit that you've put your finger on a curious problem for the Santa Fe. We haul our average passenger 565 miles, or eight times as far as the national average. This means that we must offer more attractive and roomy accommodations than a short-haul railroad, if we want to keep our patrons. At the same time, it's obvious that the more revenue seats we can build into a coach the better chance we have to show a profit.

"To solve this dilemma, we've borrowed the old carpenters' axiom that the cheapest way to build a house—or a coach, in our case—is up. You get more floor space for your dollar."

Looking down the long expanse of "hi-level" coach deck, with its 72 widely spaced seats extending from car-end to car-end, I began to get the idea. By moving entrance and exit vestibules, washrooms, and equipment and storage lockers downstairs, El Capitan coaches offer half again as much revenue space as an ordinary car. Its seven coaches are doing the work of nearly eleven.

"Put it this way," said my Santa Fe guide. "Each of these new cars weighs 80 tons, or 20 tons more than the old El Cap coaches. Yet in all they represent a saving of nearly 100 tons in train weight."

As he spoke, the muffled melody of a dinner gong floated in upon our conversation, and a baritone voice boomed cheerfully: "First call for dinner, folks."

Heading toward the diner, the guide at my side, I felt my brogans sink into rich, springy carpeting that extended unbroken, except for two doors, into El Capitan's hi-level dining car. There, he tossed me another statistic.

"We use four more sets of El Capitan equipment identical to this, plus a couple of standby coaches, to maintain daily service east and west. If all of the carpeting in our 47 El Capitan cars had been woven into one rug it would cover two-thirds of a football field."

Like our coach, the diner impressed me at once with an unusual dividend of this hi-level equipment. That was the almost complete sense of detachment from the rails. As the man from Massachusetts had put it, this was like flying without the noise. We were streaking across the desert, not at El Capitan's top speed of 90 miles per hour, but at a respectable 80. Yet the sound-dampening extra four feet below the floor absorbed every trace of track noise, giving full play to the nuances of soft dinner music.

"***Two magnetic tape recorders*** are

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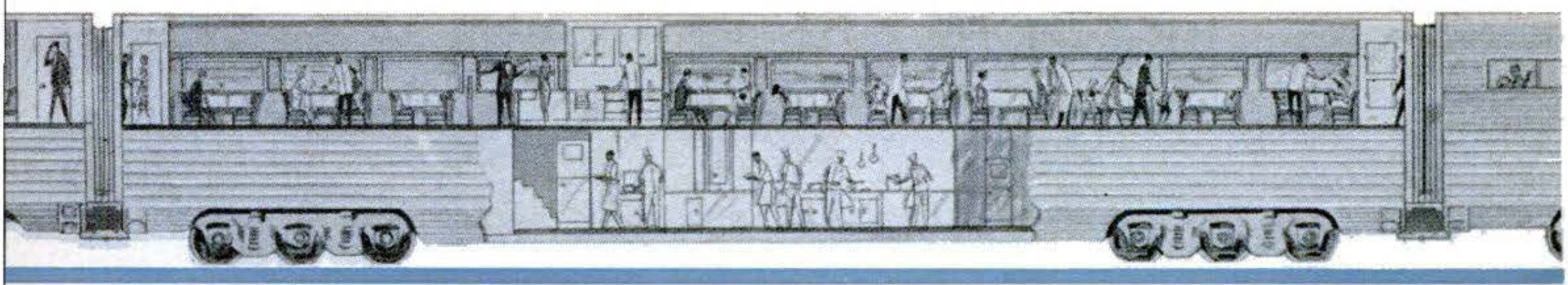
the diner 80. The old El Capitan had two diners to feed 72.



installed in the lounge car," my guide informed me. "Both of them work continuously, one dishing out popular music, the other semi-classical. The stuff is piped all over the train, with push-button selectors in every car. El Capitan passengers get what they ask for—radio reception, too, although it's a bit tricky. We generally save the radio for sports and news coverage."

As we settled down to an appetizing meal, I was conscious that the chatter of wheels on rails was not the only thing that was missing. There was no dancing of water in the tumblers, no fidgety silverware, jingling like a distant ensemble of Swiss bellringers. Vibrations, it appeared, leveled out by the time they reached the top deck.

But my guide had gone back to his favorite subject—train weight.

"There are 80 seats in this car," he told me. "El Capitan used to carry two conventional diners with a combined capacity of only 72. So, here again, we're saving 60 tons. Even with this diner, an 80-ton lounge car, a crew dormitory car and a mail-and-baggage car thrown in for good measure, the total train weight of the new El Capitan shrinks to only 3,628 pounds per passenger. That's nearly a ton less than the per-passenger weight of the equipment that it replaced.

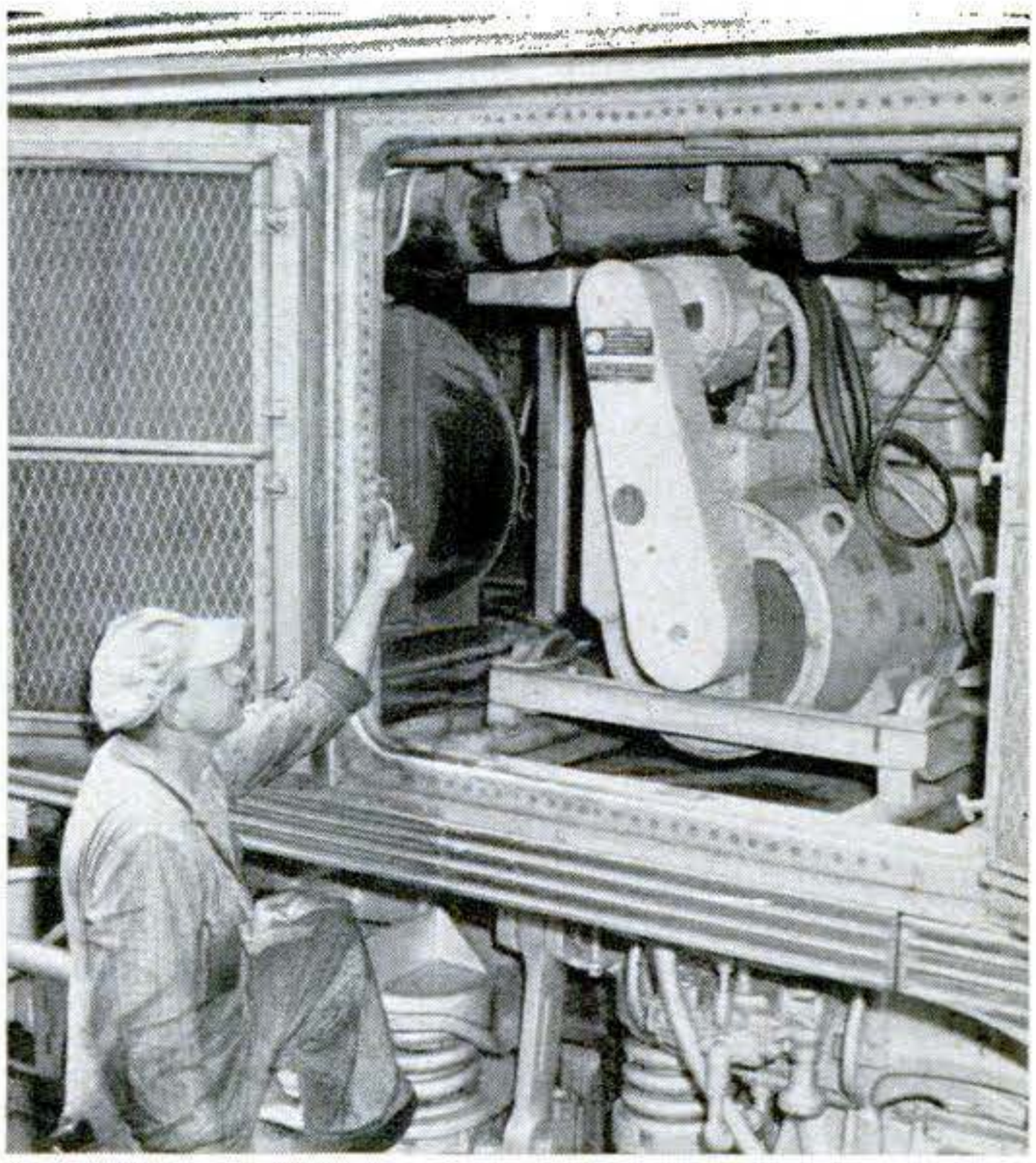
"What's more surprising: If one of the track-skimming lightweight cars on a Talgo or a Train X were fitted out with comparably wide-spaced seats, it would weigh only seven pounds less, per passenger, than an El Capitan coach."

Our meal finished, we went down a flight of stairs to the below-deck, all-electric kitchen.

"There are enough steps inside this

[Continued on page 240]

ALL-ELECTRIC, air-conditioned kitchen has three ovens, four hotplates. It also has refrigerators and an electric dishwasher. Electric dumbwaiters carry food up to the dining level.



TWENTY-TON REFRIGERATION UNIT air-conditions the El Capitan's two-level lounge car. It's the same type used in the diner. Lounge has one 60-kw. diesel generator; diner has two.

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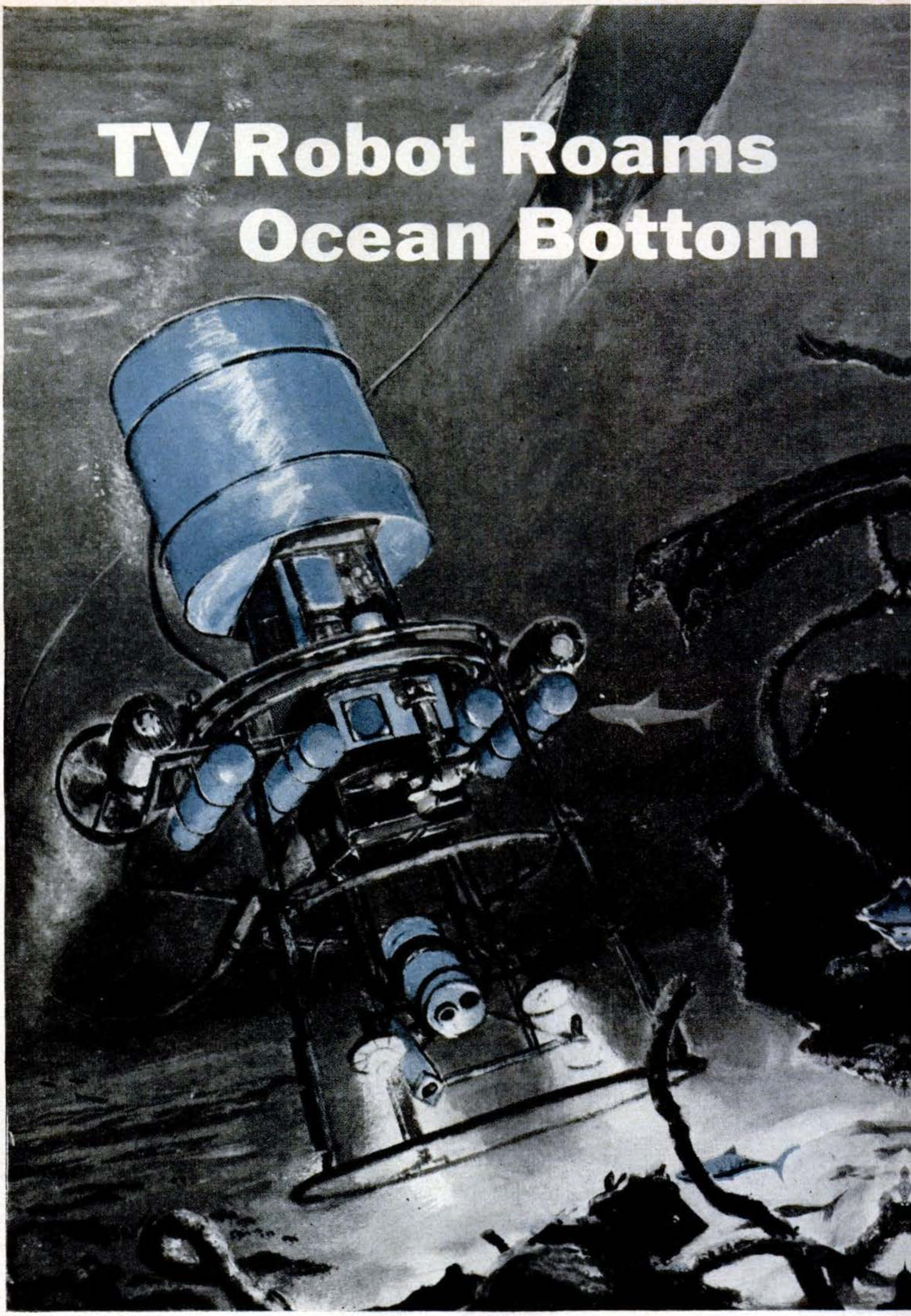
TV Robot Roams Ocean Bottom



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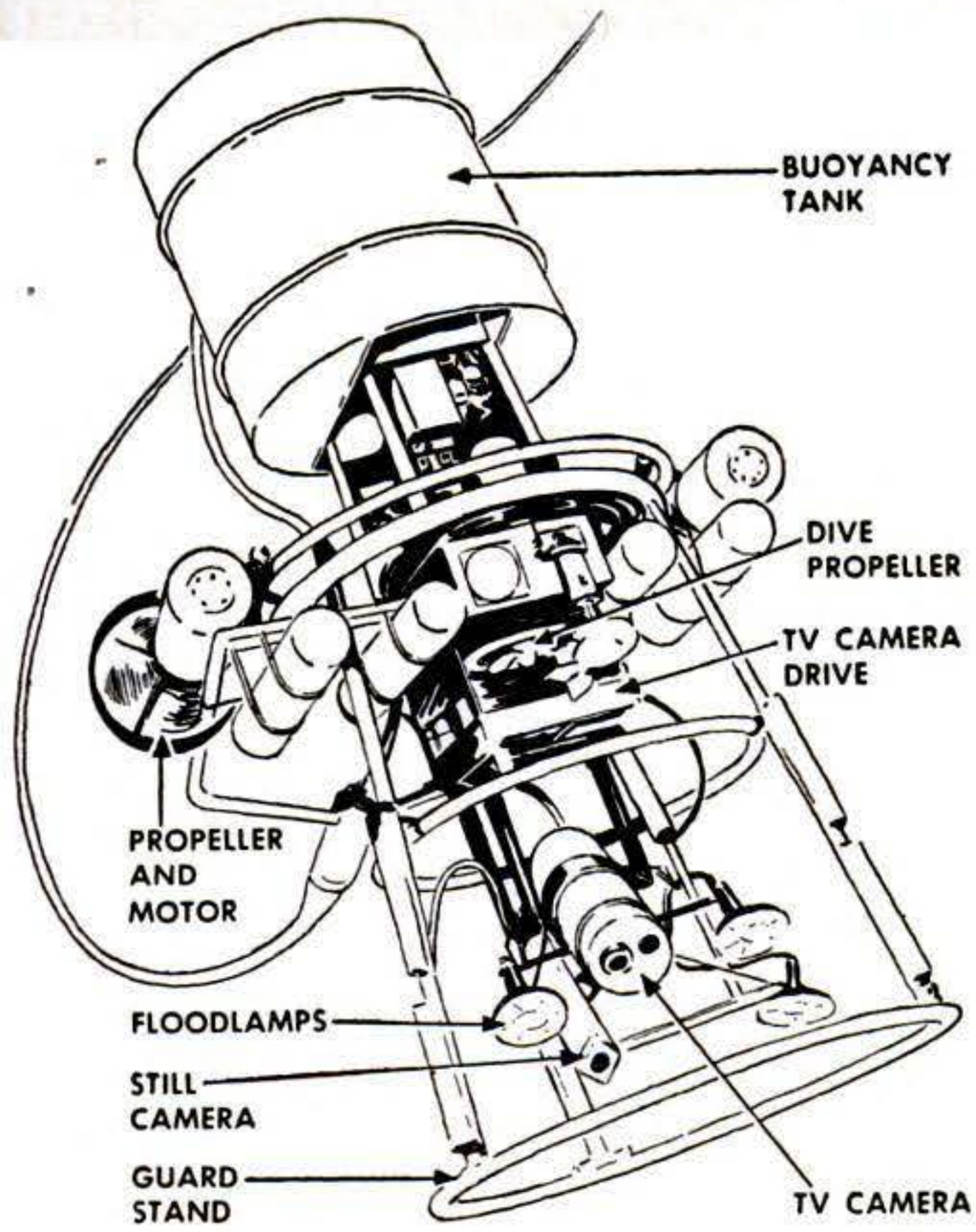
DEEP-SEA DIVER sits at bottom of a Navy training tank (top photo) to pose for underwater TV camera carrying its own high-intensity floodlight. Lower photo shows what was seen on monitoring screen. Below and at left are an artist's drawings of Navy's new self-propelled rig that takes the camera on remote-controlled submarine viewing missions.



Navy's Project Fisheye is making the life of deep-sea divers less hazardous. Part helicopter, part sub, this weird rig carries a TV camera underwater to solve riddles in Davy Jones's locker.

By Herbert O. Johansen

TV IS now going underwater in perhaps the strangest and most gadgety craft to join the U.S. Navy since John Ericsson came up with his cheesebox-on-a-raft Monitor in 1861.

The chief television expert of the Navy, J. R. R. Harter, describes it as a sort of submarine "helicopter."

A horizontal diving rotor takes this 12-foot-high, 3,200-pound remote-controlled mounting rig for a TV camera up and down; two vertical propellers give forward motion. They are driven by three 10-hp. electric motors that are free-flooding, which means that they are not affected by water. A microphone tells the robot's surface operators whether the buoyancy-tank valves are working, the propellers running smoothly, the motors responding to throttle controls. Accurate remote navigation is provided by a gyro compass. Power comes from the mother surface ship through a cable 2,000 or more feet long, which also carries the closed-circuit TV line.

The TV camera itself, a highly sensitive, image-multiplier orthicon job specially designed by the Navy, is sealed within a watertight steel casing. But by remote control, its shipboard operator can change focus, make lens-opening adjustments, and even shift between wide-angle and telephoto lenses.

An auxiliary still camera also goes along—and not just for the ride. It can be triggered to snap views wanted for further study or as permanent records.

A battery of lights furnishes illumination. There are tiny but powerful mercury-vapor lamps (which concentrate their light in the blue part of the spectrum) for black-and-white; or xenon arc lamps (less powerful, but spanning the whole color spectrum) for color TV.

Perhaps the first use of underwater television, using makeshift equipment, was in a visual survey of the radioactive wreckage of ships sunk during the Bikini atomic-bomb test of 1947.

Some $64,000 questions have been answered for

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the Navy since then through the use of underwater TV.

What was the large, unknown object submerged under the Atlantic in the vicinity of Block Island, off Rhode Island? It had been picked up by sonar, the system that uses sound waves to detect underwater objects. Since the object was in a depth-charge practice area containing unexploded charges, a deep-sea diver could not be sent down to identify it.

An underwater TV camera was lowered and showed surface observers video pictures of the wreckage of a German U-boat that had met its end in the last week of World War II.

Why did the Martin Seamaster, prototype of our first multi-jet seaplane, explode in mid-air and crash into Chesapeake Bay? Recovery and examination of the wreckage could help answer that one—but it was scattered over an area three miles long and half a mile wide. It would have taken hundreds of hazardous deep-sea dives to verify whether this or that sonar-detected object was a vital part of the wreckage. Underwater TV went to work again and checked quickly on each sonar find so that it could be selected for recovery or rejected by engineers watching a screen.

Incidentally, the new electronic fisheyes made possible the almost immediate recovery of the bodies of the crewmen who went down with the plane.

The Navy foresees many other uses for underwater video. It will be invaluable in rescue operations of a disabled submarine, especially in the ticklish task of fitting the diving bell to the escape hatch. Hulls, propellers and rudders of ships can be examined without expensive drydocking.

TV surveys for underwater construction will make such work safer and faster. In salvage operations, divers can take a video look before going down, to see what they are getting into and prepare for unusual hazards.

Timesaving is important, too. The TV camera doesn't have to worry about water pressure, but a diver does. His stay below is limited. When working at depths of 200 feet, the time spent lowering and raising a diver is greater than the time he can spend on the bottom. Also, a diver walking on the bottom may raise clouds of silt, obscuring his vision. A camera rig does not have to touch bottom to do its job.

The elaborate submarine helicopter is not necessary for all types of fisheye operations. Often, lowering just the basic remote-controlled camera in its watertight casing is adequate. Motion and direction are supplied to the camera by maneuvering the mother ship.

On some jobs, the camera-and-casing is mounted below a glider structure towed behind a ship at slow speeds. Movable diving planes on the glider are remote-controlled to make the camera dive or surface.

Underwater lighting is tricky. In murky water an artificial light on a camera, however powerful, may be a hindrance instead of a help because particles in the water reflect the light back into the camera. It is like trying to take an ordinary flash photo in a snowstorm. Devices are being studied to extend the lamps away from the camera to give side, or even back, lighting to objects being televised. And Harter feels that research now under way will let TV cameras "see," to a reasonable extent, in even the muddiest of waters.

Another logical next-step in underwater TV is to give it the "ears" of sonar—combining sound detection with eye inspection.

How good a picture do you get? Under average conditions, a sharp picture of an area from 15 to 20 feet across can be obtained with the camera 20 feet away. In one case, observers at a video monitoring screen were able to identify sunken ammunition by the letters and numerals on the shells.

On a recent operation off Bikini, a crewman decided to take the chance out of fishing. He watched the monitor until the kind of fish he wanted appeared on the screen. Then he waited until a really big fellow came along—and dropped his baited hook practically into its mouth.

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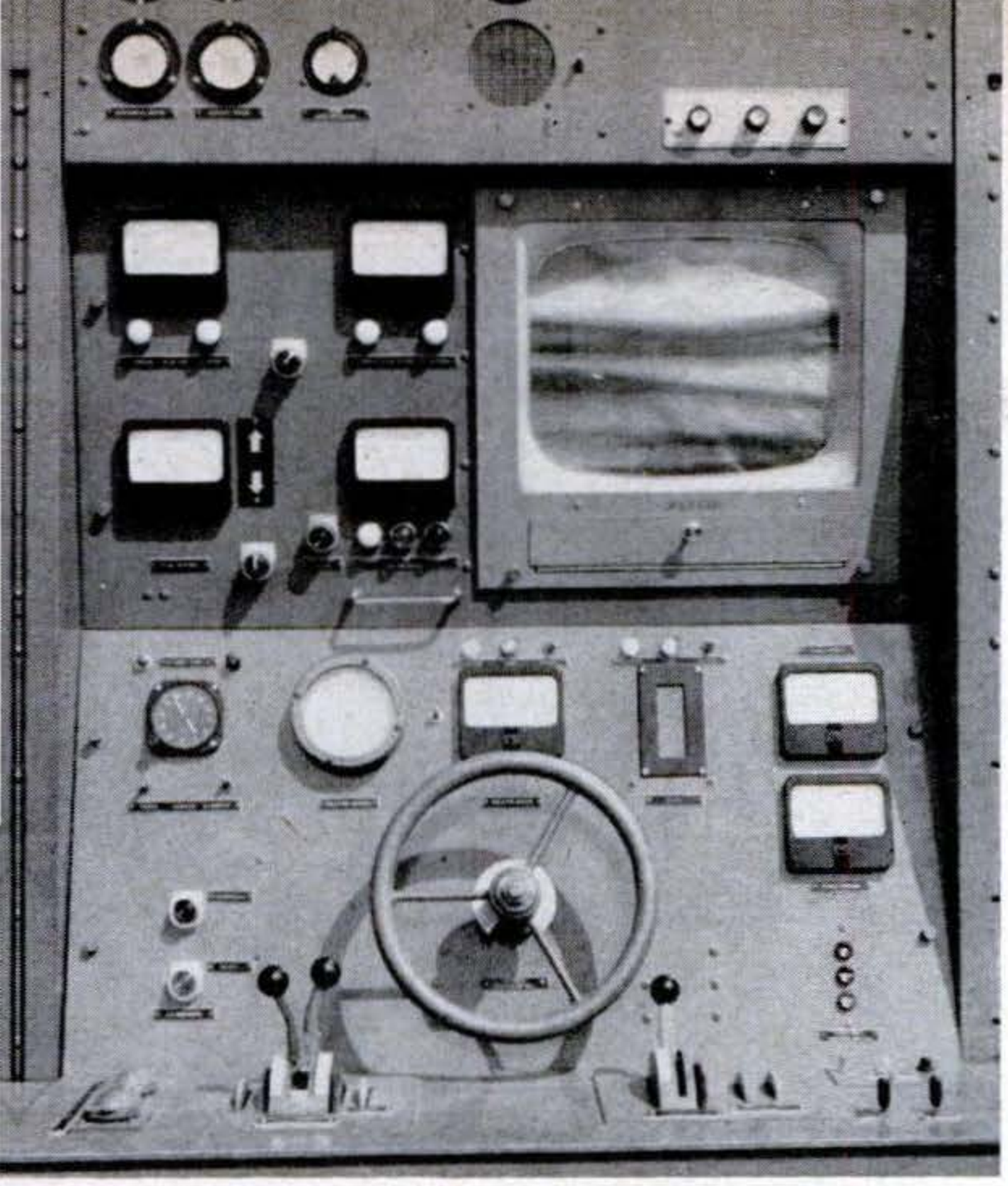
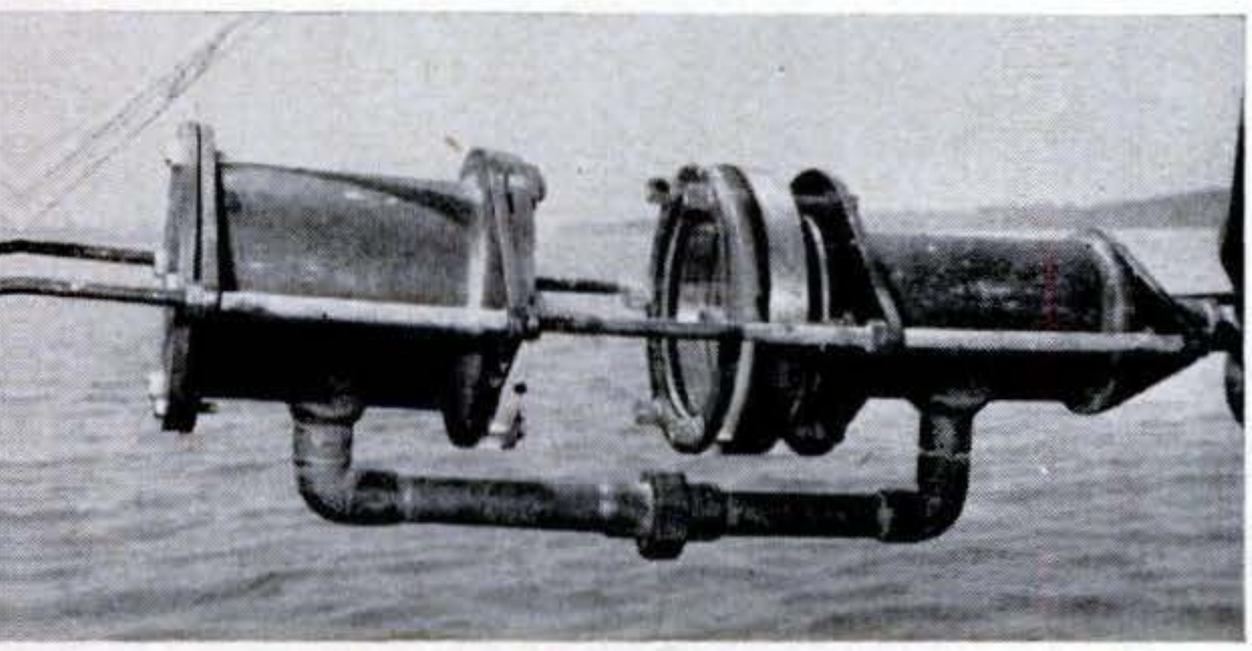


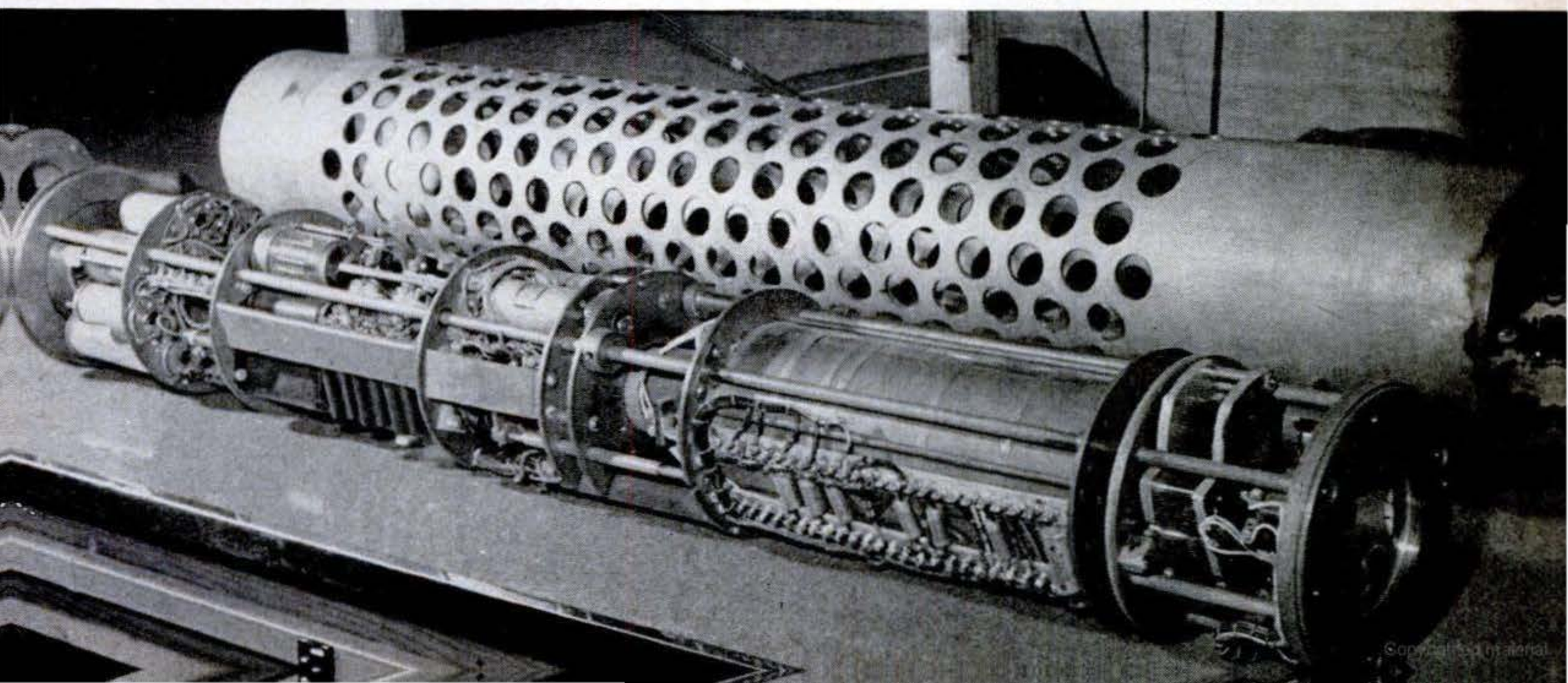
ROBOT'S CONTROL and monitoring panel. Wheel is for steering. Knobbed handles are for controlling speed, dive and surfacing of underwater craft. At top right is TV viewing screen.



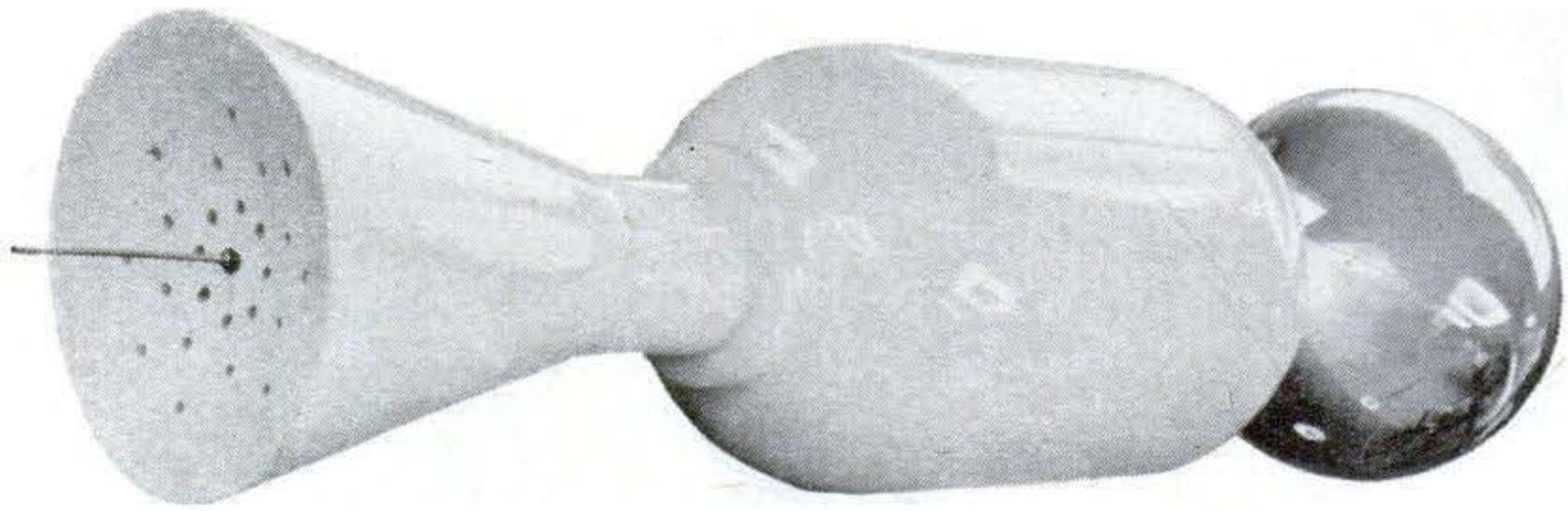
UNDERWATER TV CAMERAS take along light meters. Photocells of the Navy Mark VII hydrophotometer above measure light-transmission characteristics of water at various depths.

READY FOR A DIVE, a 140-pound TV camera unit is guided over the side. Pressure-resistant housing is stainless steel. Floodlight is attached to the vertical rod at the forward end.

COMPACT ARRANGEMENT of the gadgety, remote-control TV camera is shown below, next to its protective shell. Lens turret is at far right. The camera weighs about 75 pounds. END

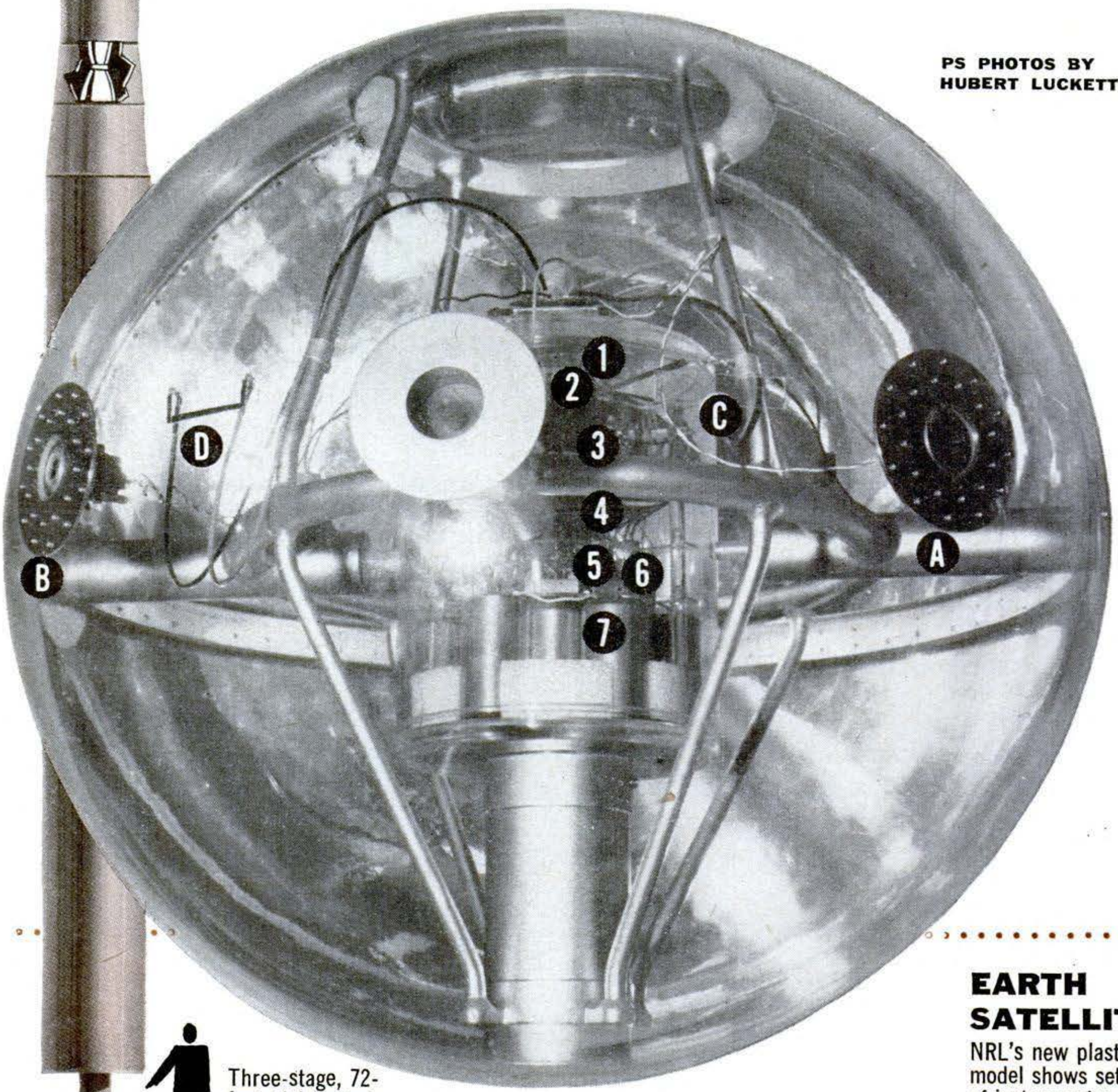


What Goes into



Third-stage rocket motor and satellite (model above) ride aloft within second stage (left).

PS PHOTOS BY HUBERT LUCKETT



EARTH SATELLITE

NRL's new plastic model shows setup of instruments:

Three-stage, 72-foot-high rocket launches satellite.

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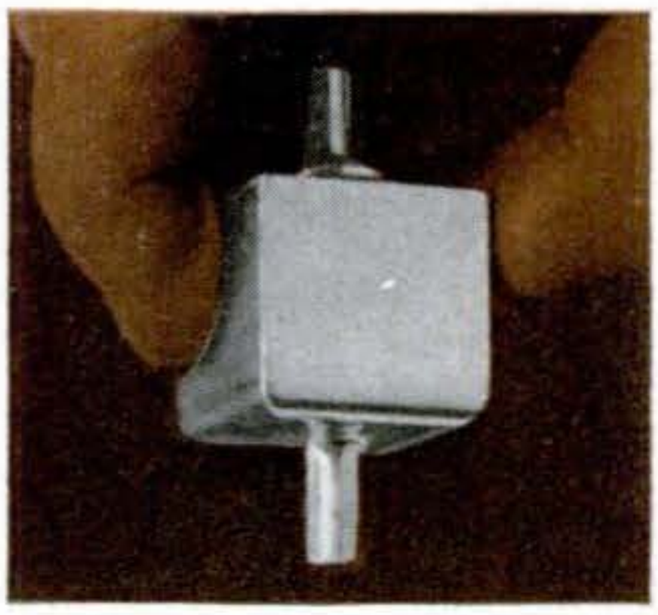
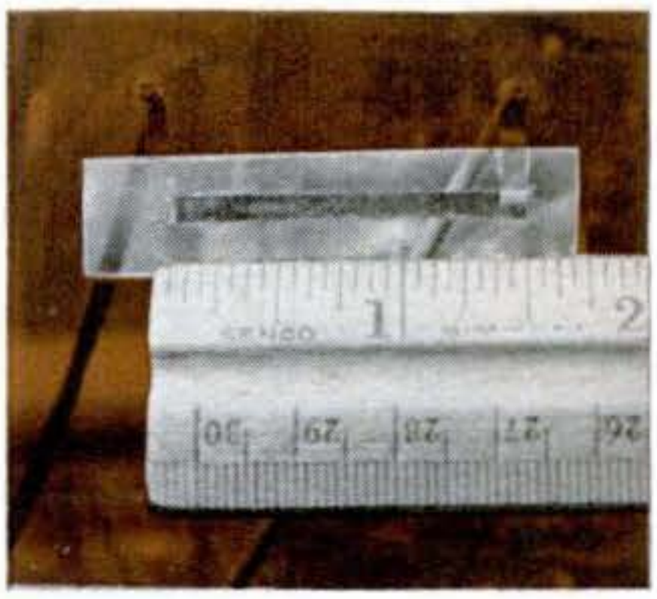
a Satellite

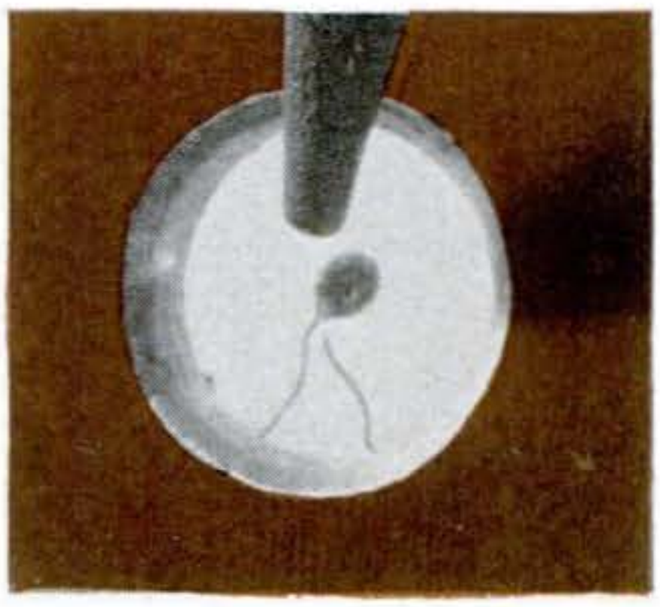
HERE'S a preview of the actual instruments that will make the first sustained observations in space, 300 miles up. Designed by the Naval Research Laboratory, the sub-miniature gauges and meters will be carried aloft by the earth satellites to be launched in Florida this year and next by three-stage rockets whose components are now being test-fired. Instrument location within 20-inch metal shell (above) is illustrated by an NRL satellite model of plastic (facing page). Like an earlier PS satellite model, NRL's shows one of many possible setups for different observations.



PRESSURE GAUGE: Will future spaceship passengers be threatened by flying meteorites, which may puncture a cabin and drain its life-sustaining air? This little gauge should tell the story. If a meteorite pierces the metal shell of a satellite, and releases inert gas sealed within, the gauge will register a telltale pressure drop to the near-vacuum of outer space. Containing a bellows-actuated potentiometer, the midget instrument weighs only an ounce and a half.



EROSION GAUGE: Meteoric dust may pit and damage the surface of space craft, and reduce the visibility of a satellite by attacking its polished-metal skin. How much, and how fast, this strip on a satellite's outside will reveal. It consists of a ribbon of Nichrome metal, evaporated onto glass to form a layer only 1/10,000 of a millimeter thick. As meteoric particles eat away the ribbon, its electrical resistance will increase, and the figures will be among those radioed to earth.



THERMISTOR: Pencil point shows comparative size of tiny satellite-style thermometer, of metal oxides whose electrical resistance varies with heat or cold. It can register from minus 200 to plus 300 degrees F. Several will take satellite's temperature inside and out. They'll check whether insulation keeps solar radiation from overheating interior and imperiling electronic components, like transistors, which can survive only about 40-to-120-degree range.

Please turn the page

A. SOLAR CELL resets memory unit, once each orbit.
B. ION CHAMBER registers ultraviolet radiation.
C. THERMISTORS take temperature of satellite.
D. EROSION GAUGE checks pitting by meteoric dust.
1. "MINITRACK" TRANSMITTER radios data to earth.
2. AMPLIFIER for microphone-detected meteoric impacts.
3. MEMORY UNIT for meteoric impacts.
4. TELEMETERING SYSTEM selects data for "readout."
5. MEMORY UNIT for ultraviolet meter.
6. AMPLIFIER for ultraviolet meter.
7. MERCURY-BATTERY PACK for telemetering system.

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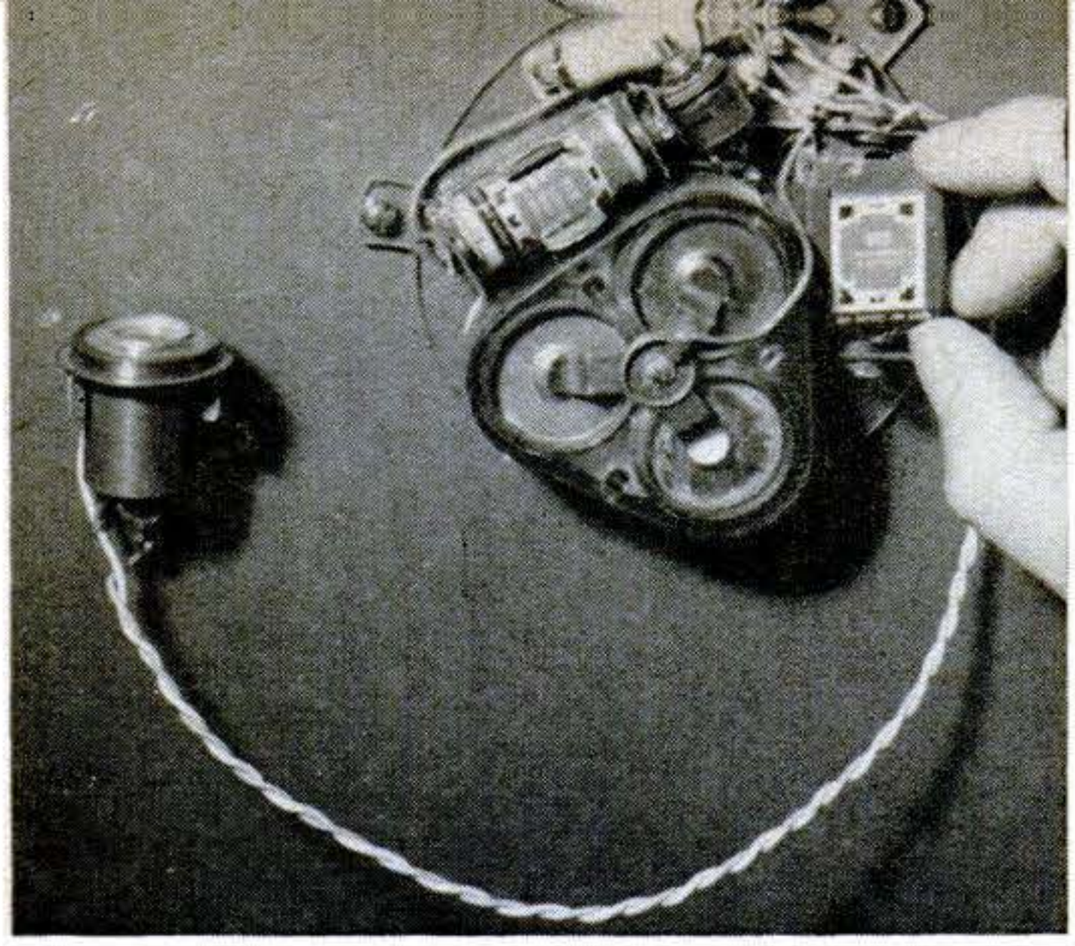
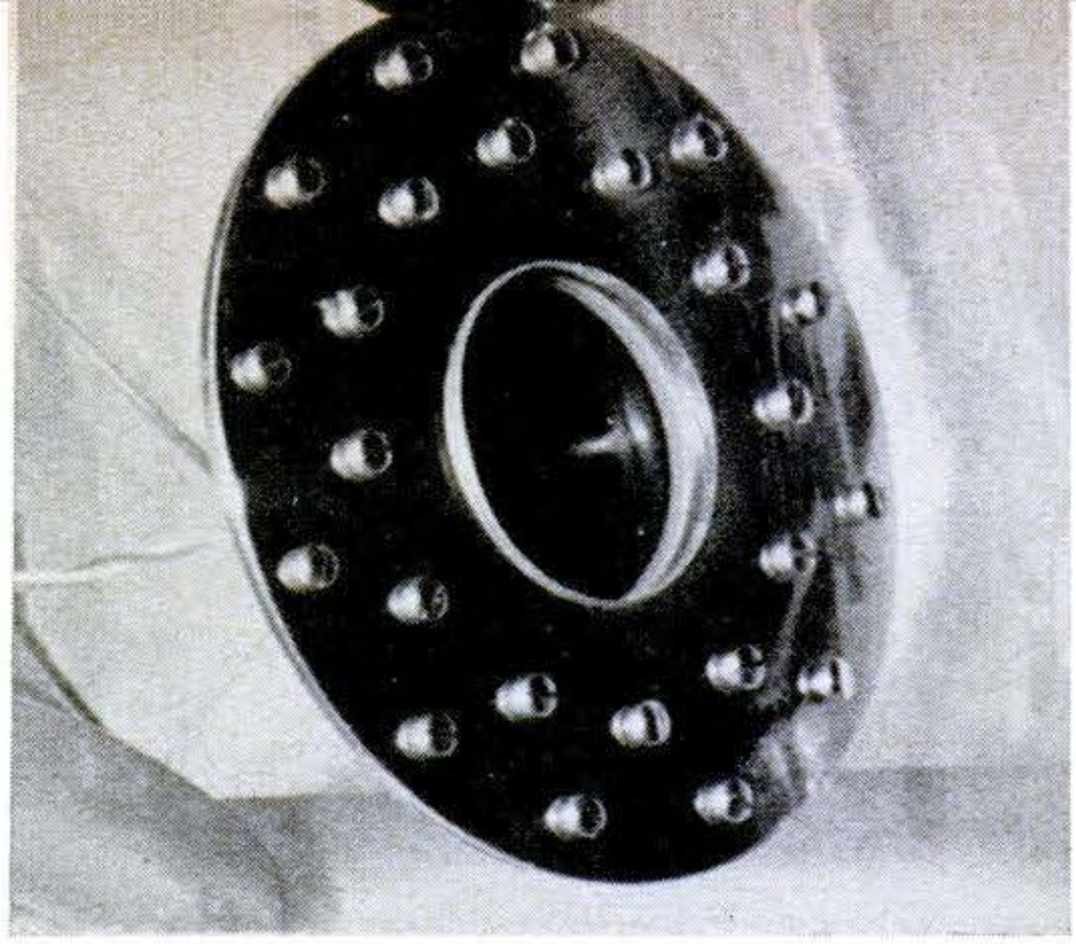


ULTRAVIOLET METER: Besides causing sunburn, the sun's ultraviolet rays play a leading part in forming the ionosphere—the high-altitude ionized layer that reflects radio waves back to earth, aiding communication. How strong the rays are beyond the atmosphere, which strains some out, this "Lyman alpha" apparatus will tell. Mounted in a satellite port, an ion chamber (far left in photo) registers ultraviolet intensity with this electrical hookup.



SOLAR CELL: Harnessing sun power to produce an electrical impulse as the satellite emerges from darkness into daylight, on each successive orbit, this device resets a memory unit that stores data for subsequent transmission to earth. For this particular task a sun-powered cell exactly fills the bill, although solar batteries are still considered a little too experimental to take the place of chemical ones as a satellite's main source of electric power.

TRANSMITTER: Pictured actual size, a satellite's 13-ounce "Minitrack" radio transmitter will provide the radio-frequency link for telemetering data to earth. With the mercury batteries shown, it will have an operating life of about two weeks. Then radio will go dead and only visual observations of satellite will be possible. Transmitter's case will actually be of gold-plated aluminum instead of the plastic one that is used here to display its inside arrangement. The transmitter will operate at a frequency of 108 megacycles and, despite its amazingly compact size, will have a sending range up to 4,000 miles.

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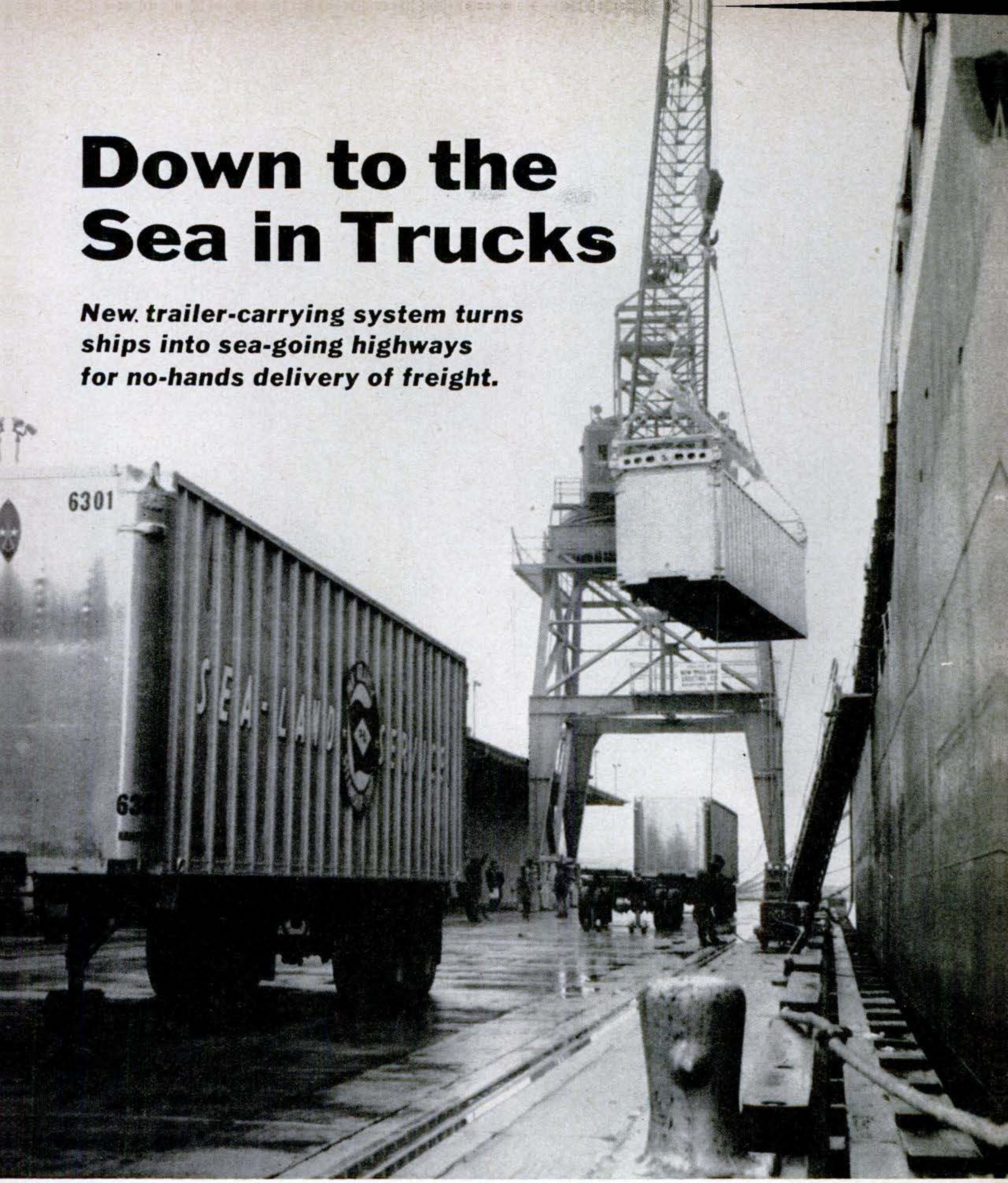
Down to the Sea in Trucks

New trailer-carrying system turns ships into sea-going highways for no-hands delivery of freight.



Hoisted aboard ship from its wheeled platform, trailer doubles as a super-crate for cargo.

By Lassor A. Blumenthal

THREE years ago a transport executive named Eric Rath sank $500 into a wild idea. Over the years, as he studied the problems of shipping goods by water, he had watched the coastwise American merchant marine being choked to death by the high cost of handling cargo: truck to warehouse to ship to warehouse to truck, to name just a few things.

Why, Rath wondered, all the handling? Why not drive those trucks aboard ship

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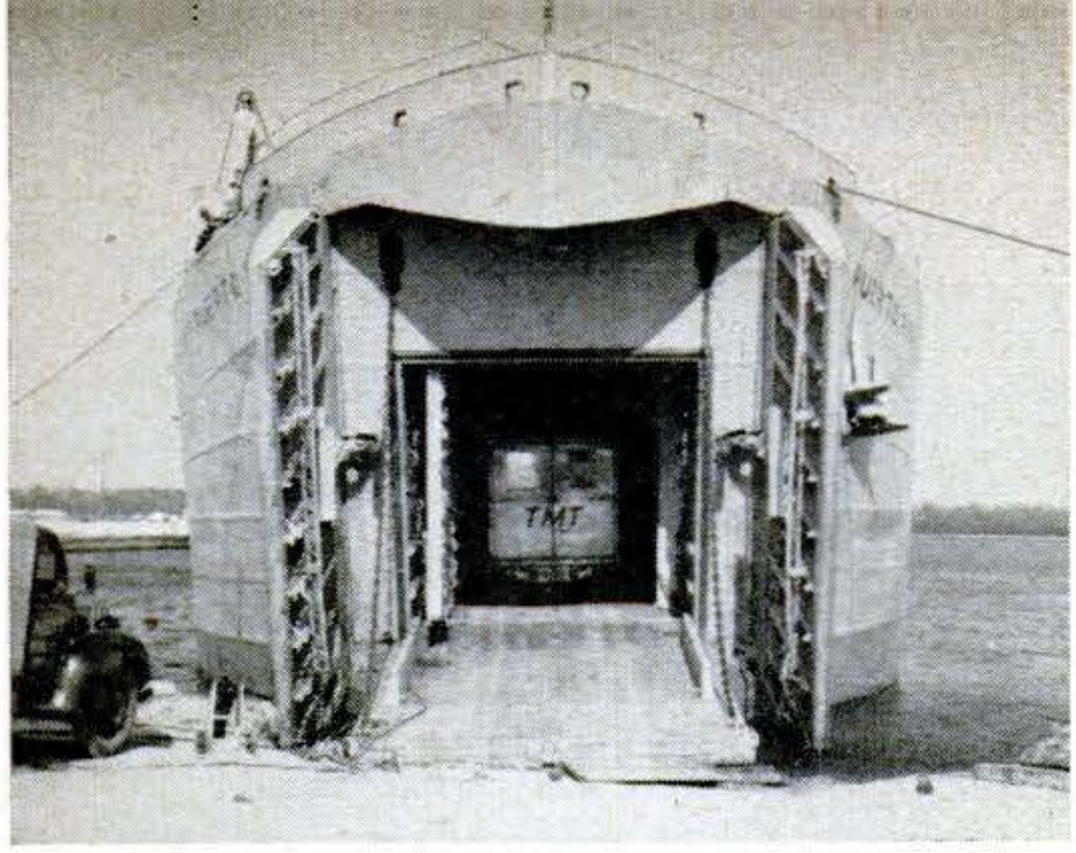
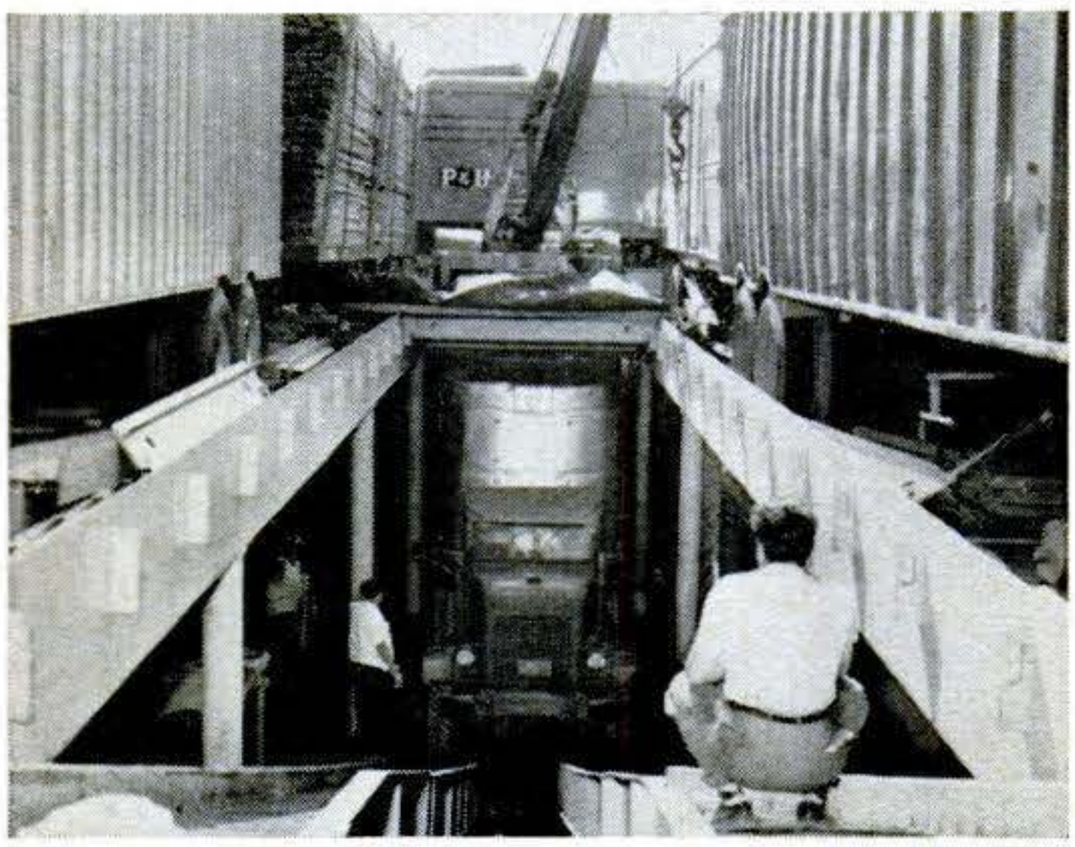


ROLL-ON, ROLL-OFF SYSTEM uses big-mouthed wartime landing ship here. TMT's 425-trailer fleet includes refrigerated trailers for perishables, padded trailers for household goods.



COMING UP THE RAMP from the stern door, a trailer is guided toward the upper deck. Extra below-deck room for trailers was provided by ripping out the LST's engine and stanchions.

FULLY LOADED, with 55 trailers and 30 autos, trailership will be towed by tugs. Main stops are Puerto Rico, Florida, Virgin Islands. TMT plans expansion to Central America soon.

—and then, at port, drive them off again?

Today, Rath's $500 has mushroomed into a $2,500,000 business, and his idea promises to revolutionize a large part of the U. S. transportation industry.

The problem Rath set out to lick was a complicated one. Say a Detroit manufacturer wanted to send a truckload of widgets to Cuba. Unless he flew them in (which would be prohibitively expensive) they'd have to go by train or truck to a seaport, then by water to the Caribbean island. This meant that the widgets had to be specially crated to withstand both overland and ocean voyages.

Once trucked to the port, they would be unloaded into a dockside warehouse to await a cargo ship. Possibly there would be some loss from pilferage—but that was part of the business. When the ship finally arrived, the crates would be hoisted aboard and stored in the hold. A few might be smashed—but that, too, was part of the business. On arriving in Cuba, the whole process would be repeated, in reverse, with perhaps a little more thievery, a little more breakage, a little more delay.

Rath's scheme for cutting out all this expensive crating, waiting, pilferage and breakage, by simply loading the truck on the ship, was not completely new.

Actually, it constituted a variation on an idea that had been started some 25 years previously by Seatrain Lines, in which railroad cars are placed aboard ship for transportation by water. If railroad cars, why not trailer trucks?

It made sense to Rath, and he talked a truck manufacturer into selling him a secondhand trailer for a token downpayment. Then, as he says, "with $500 and a million dollars' worth of galvanized nerve," he leased space on a freighter making the Florida-Puerto Rico run. On August 10, 1953, when the ship got underway with Rath's trailer aboard, the trailership industry was born.

Today, Rath's TMT ("Tomorrow's Methods Today") Trailer Ferry fleet consists of five craft; in addition, he is converting a 475-foot freighter, the Carib Queen, which will carry close to 100

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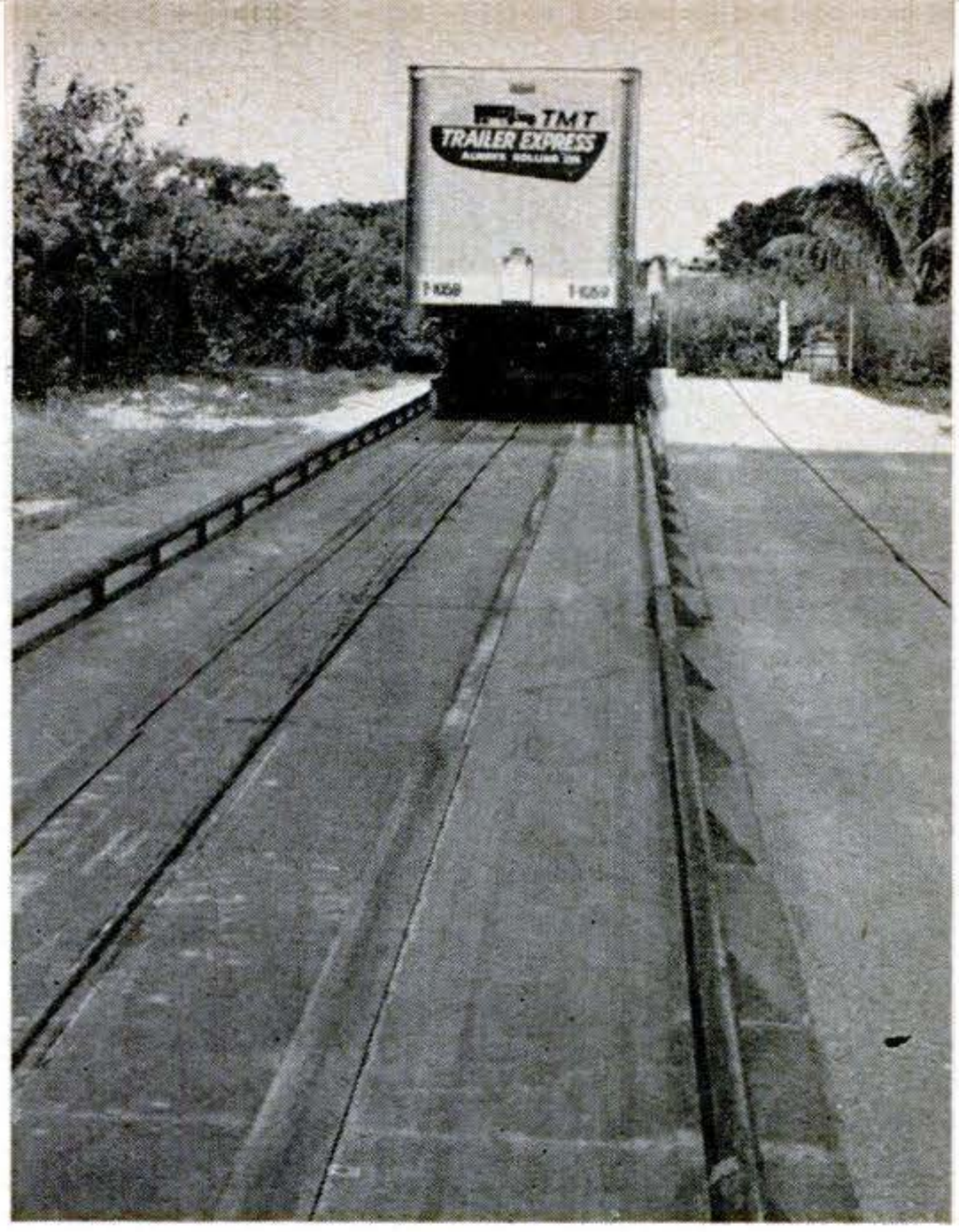
trailers and 100 automobiles besides some 500 or 600 tons of bulk cargo and a few passengers.

While Rath's fleet is the only one that constitutes 100 percent trailership roll-on, roll-off operation, the trailership idea gives promise of reviving American coastal and intercoastal shipping. Pan-Atlantic Steamship Corp., for example, has plans for the immediate construction of roll-on, roll-off ships. At least three more companies—American Hawaiian Steamship Co., Alaska Steamship Co. and Browning Steamship Co.—have concrete plans, while still others are showing increasing interest.

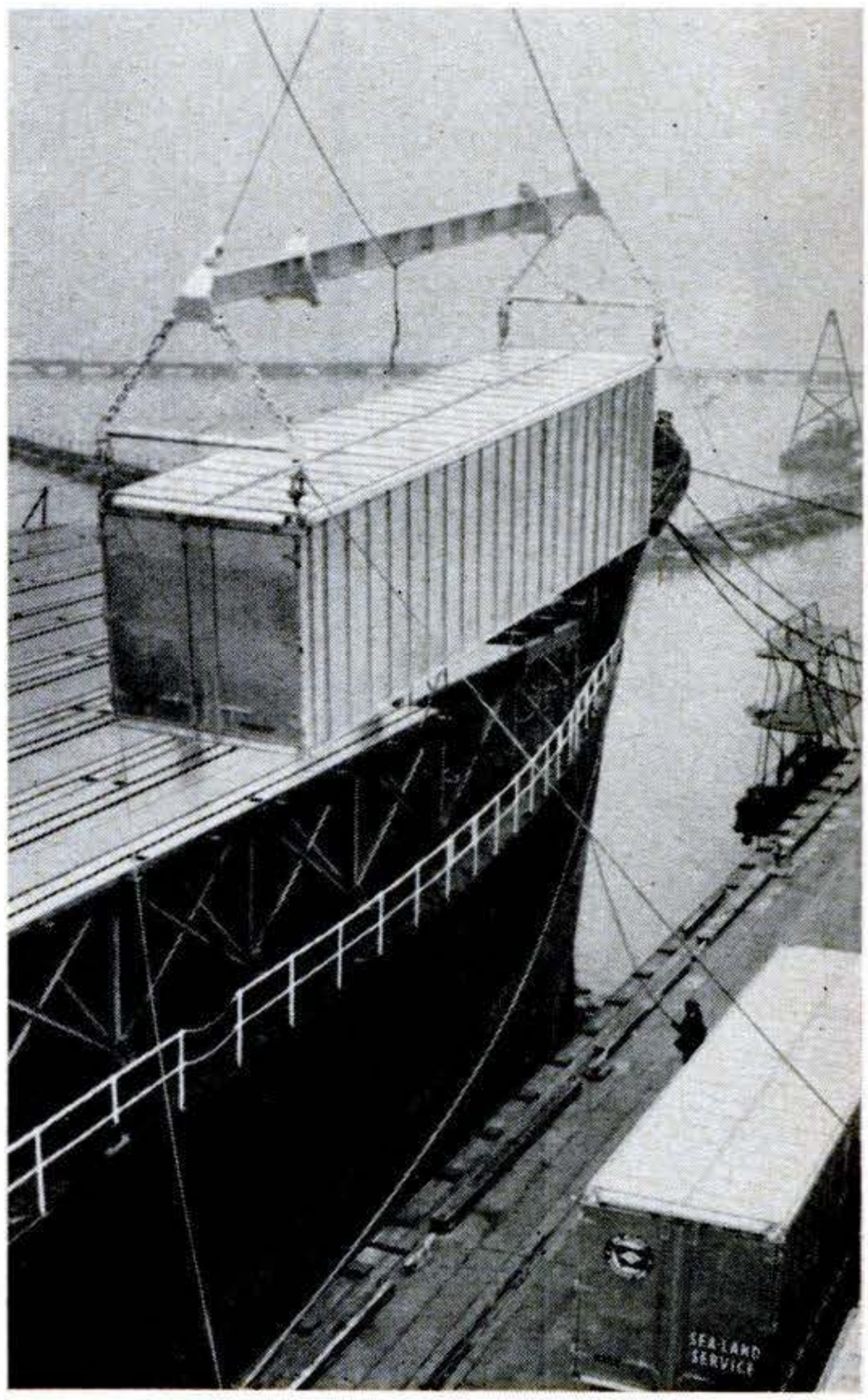
How do trailerships work? Actually, there are two types in operation now. In one case, the trailer is hoisted onto the ship by a crane or other lift mechanism. In the other system, the ship is designed with openings in the sides or stern, and the trailer is driven directly into the hold. In both cases, before the trailership firms could operate profitably, they were beset by enough headaches to keep an aspirin company working round the clock.

For example, in the lift-on operation, the shippers quickly realized they could save space by leaving behind the heavy undercarriage and lifting only the trailer box on board. This led to the development of a new type of truck. What has emerged is a trailer that clamps to a platform attached to trailer wheels. After the truck is driven alongside the ship, the clamps are unlocked and the trailer box is hoisted aboard. At its destination, the box is lifted off, clamped to another rolling platform, and driven off.

Or take the roll-on, roll-off method, where the trailer is driven on board. Pioneer operators discovered that truck springs designed for road operation were a little too bouncy on the high seas. On one stormy day when heavy waves were making the springs bounce like yo-yos, Rath lost a couple of trailers over the side. He remedied this trouble by substituting deflatable air springs for the standard metal ones. Now, when a trailer is anchored aboard a trailership, the air



"TRAILERLOAD" SYSTEM will eliminate tractors on TMT's Carib Queen, launched in October. Setup shows how dolly will support trailer between rails as moving cable pulls it on ship.



SEA-LAND CONTAINER is swung aboard Pan-Atlantic Line's Ideal X, bound from New York. Trailer bodies peg into holes in deck, at Houston will be refastened to chassis for delivery.

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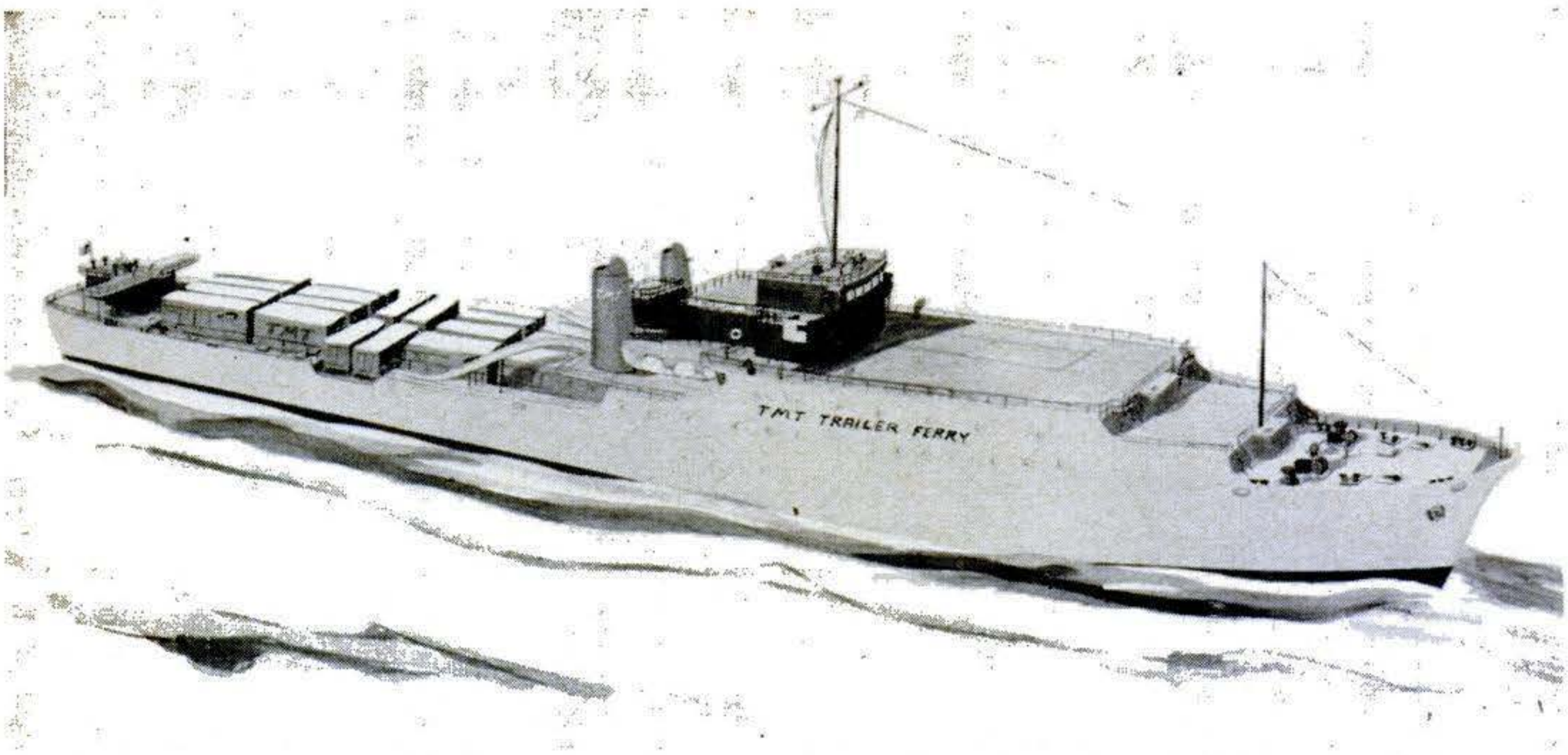

CARIB QUEEN, using a cable drum to reel in its trailer cargo, will load in four hours, TMT says. Now being fitted out, it is the first vessel to be designed from scratch as a trailership

is let out of the springs, and the trailer settles down, safe against almost any kind of sea.

Dock facilities and port locations are being affected, too. Since goods traveling by trailership can remain in trailers while awaiting shipment, dock storage sheds can be eliminated. To save transportation costs, many new piers will probably be located outside congested city areas. In some cases, nearby small towns will handle the new traffic. Says Paul A. Amundsen, executive secretary of the American Association of Port Authorities: "We're on the threshold of a greater change in port development and operation than any we've experienced in the past 40 to 50 years."

The changes have begun already. Cleveland is planning six new berths "with the trailership in mind." San Francisco is clearing one dockside area to make a trailership parking lot, and 40 acres have been reserved for another site. In Beaumont, Tex., finishing touches are being put on a new pier designed for truck ships.

The trailerships plying the coast now don't look different from regular freighters. The reason: Most of them have been converted from standard merchant vessels. Rath's first craft was a Liberty ship, which had done duty in World War II. Now he's using three LSTs, which can handle about 50 loaded trailers each. In addition to the LSTs, he has two smaller, self-propelled trailerships for inter-island service. Pan-Atlantic is using three 253-foot standard tankers, each of which carries liquid cargo in the hold and 58 trailers on deck.

Trailerships designed expressly for the new type of transportation are now being—or will be shortly—translated from blueprints into steel. While every company has its own favorite plan, the U. S. Maritime Administration has recently released a high-speed roll-on, roll-off design that may well be adopted as a standard. (Experience seems to indicate that roll-on, roll-off, because it's faster and cheaper, will eventually replace lift-on, lift-off.) The Government model, a sleek, 20-knot triple-decker with an overall length of 518 feet, will hold 200 trailers.

Designed with an eye to the future, the ship has a cruising range of 3,000 miles—a figure that may be the key to the future of trailerships. For, although shippers are reluctant to talk about using trailerships for anything but coastal transport—or at most, inter-coastal between the U. S. and South America—the 3,000-mile cruising range indicates that before long U. S. trailerships may be spanning the oceans of the world. When that day comes, not a small share of the credit will be due to Eric Rath. END

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Warship Showers Off "Fallout"

SAILORS aboard the USS Purdy walk the decks in a downpour as the destroyer drenches itself from tip of mast to waterline in a practice test to wash down radioactive fallout. In seconds, thousands of tons of water spray through permanently installed lightweight plastic pipe to clean off lethal contamination. The system will allow a ship to remain in action during nuclear warfare.

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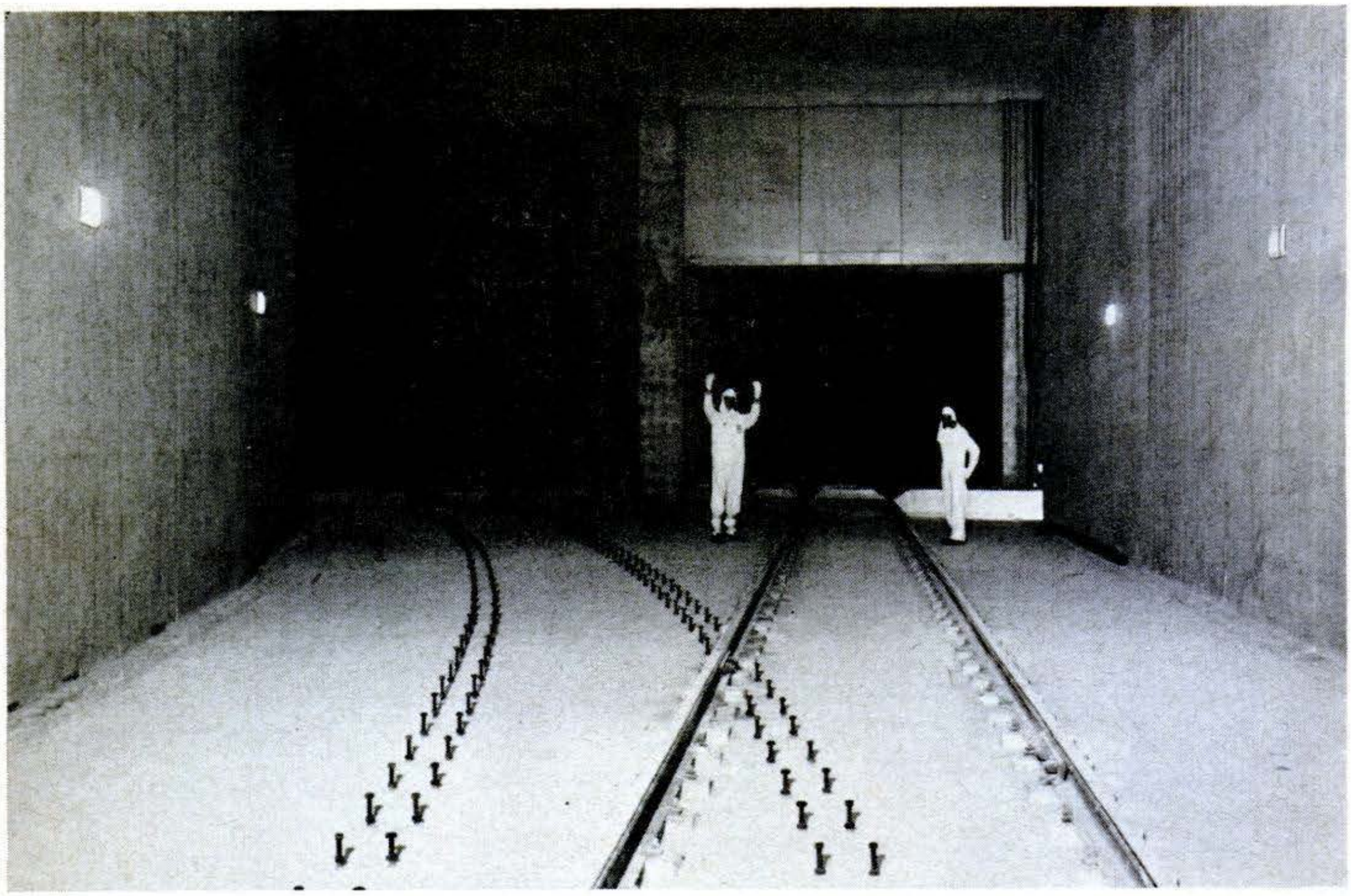

Tunnel Is Tomb for Atomic Plant's "Hot" Scrap

RAILWAY cars that go into the black hole at right above never come out. Their freight is worn-out radioactive equipment too "hot" for repair, at the AEC's Hanford, Wash., plant. The door, shown raised, is a concrete, water-filled radiation barrier. When this 500-foot-deep cavern is filled with 12 cars, the second (left) will be completed.

Paper Dance Floor Gets a Gleam

HEAVY paper, painted with colorful designs, is the foundation for this novel dance floor created by scientists of Philips Research Laboratories, electronics firm in Eindhoven, Holland, for a company fair. A smooth, gleaming finish of waterglass is shown being applied above.

Light Fixtures Heat Church

THESE double-duty ceiling lamps have built-in infrared heaters. A single reflector on each fixture beams both light and heat downward over the heads of the congregation. The system was installed by a South German church in preference to electric radiators at floor level.

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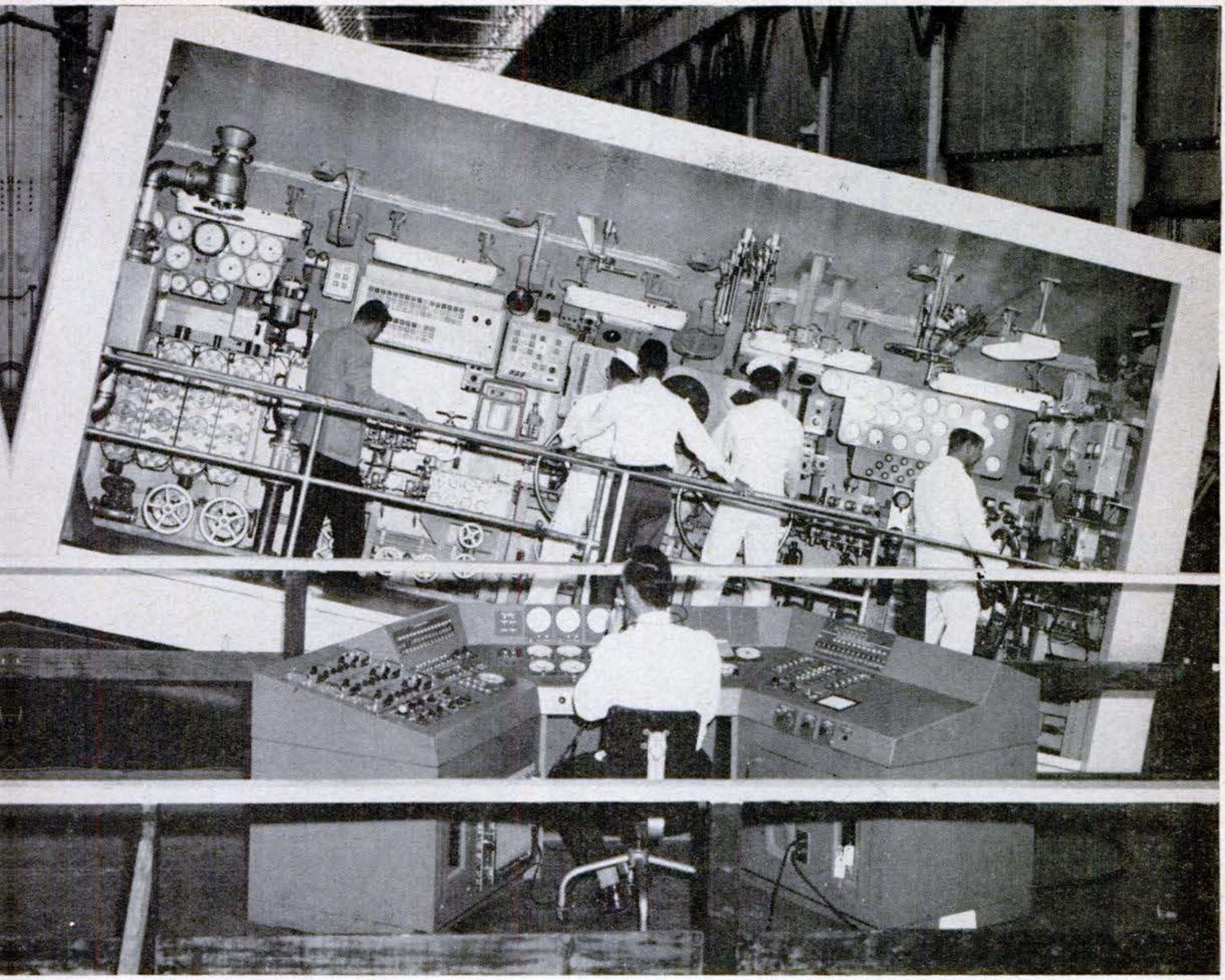

Submarine Trainees Get Dockside Rock-and-Roll

REALISTIC gyrations of a submarine in action are duplicated in this tilting room which simulates dives, turns and climbs. An instructor seated at the console (foreground) can feed in heavy weather, torpedo firing or engine failure. The hydraulically operated trainer is in use at the Navy's New London, Conn., submarine school.

Airport at Las Vegas Has Thunderbird Crash Wagon

SUITING the plushy mood of the fabulous Nevada resort, a high-stepping Thunderbird is on emergency crash duty at Las Vegas' McCarran Field. Fitted with fire extinguishers and a two-way radio, the speedy Bird can reach any spot on the airport in 90 seconds flat.

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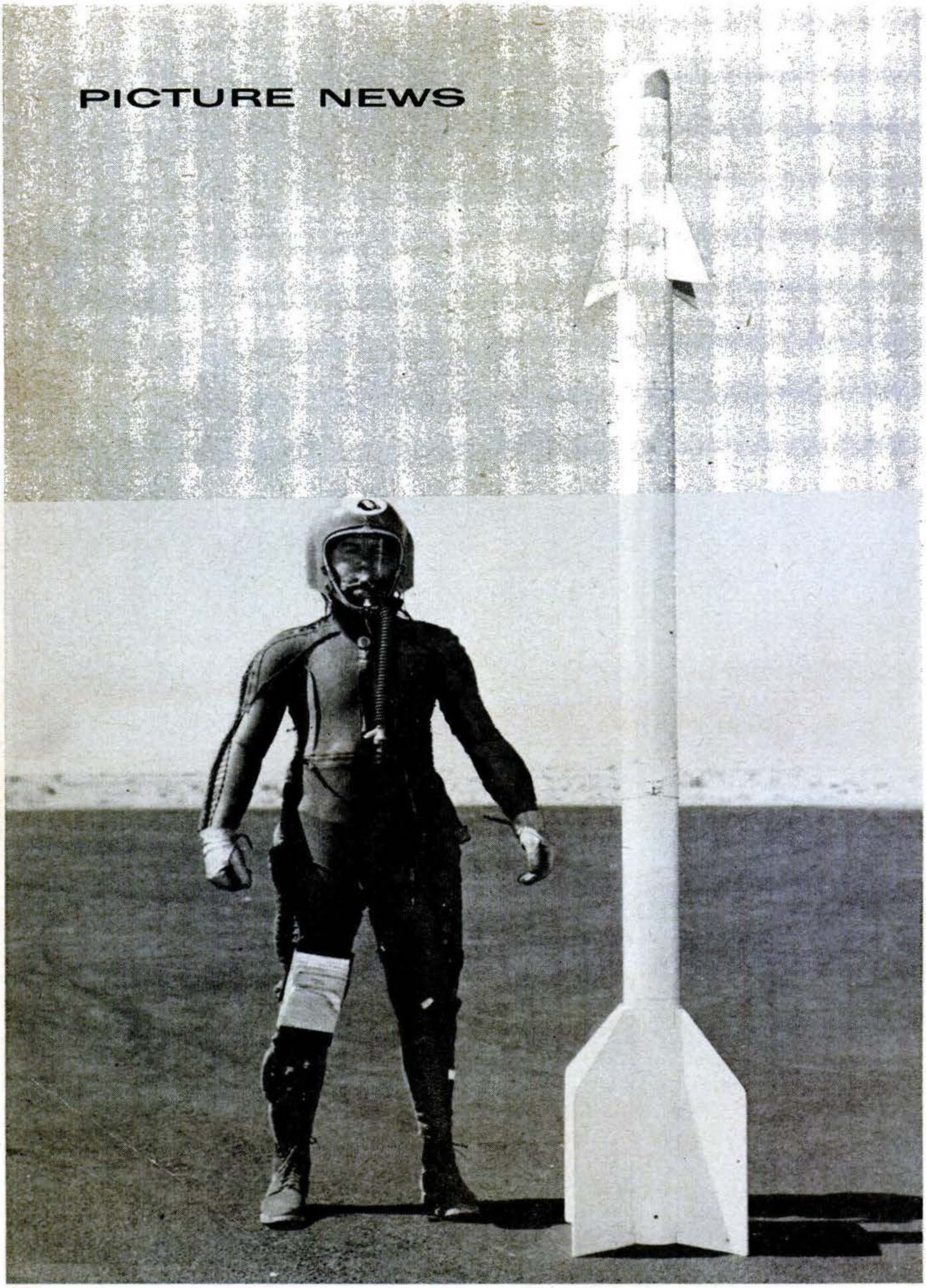

Navy's New Fighter Missile Has Deadly, Accurate Bite

THE "Sidewinder," latest of the Navy's air-to-air missiles, stands next to the man who will fire it, a jet pilot. Named for a vicious rattler, the Sidewinder can be fired singly or in salvo, and "homes" on an enemy plane by the heat the plane gives off.

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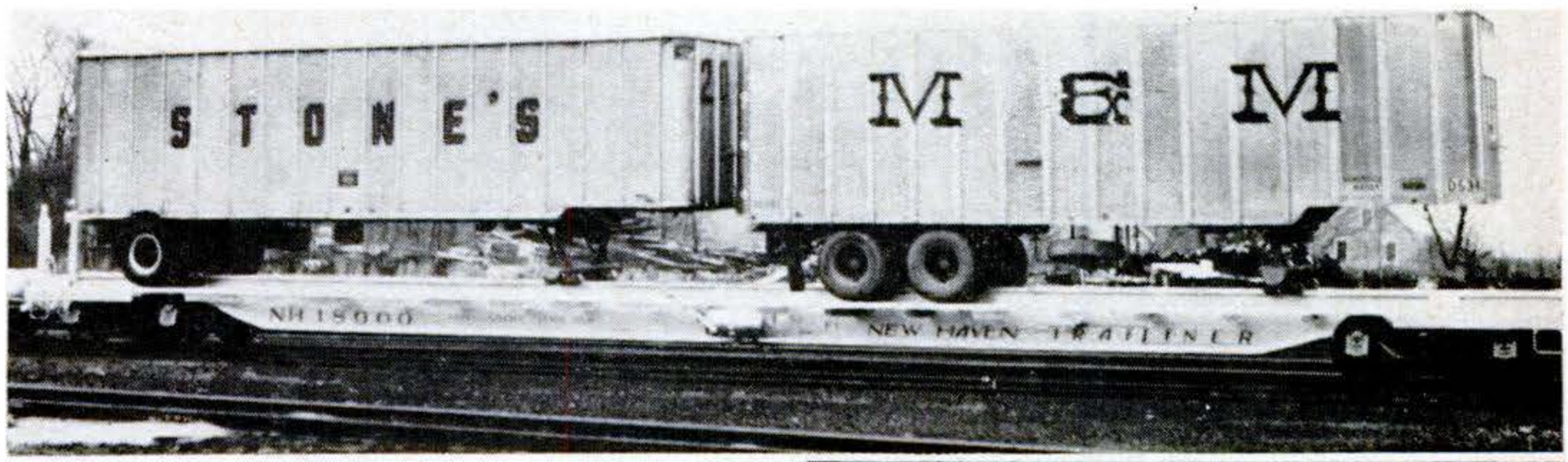
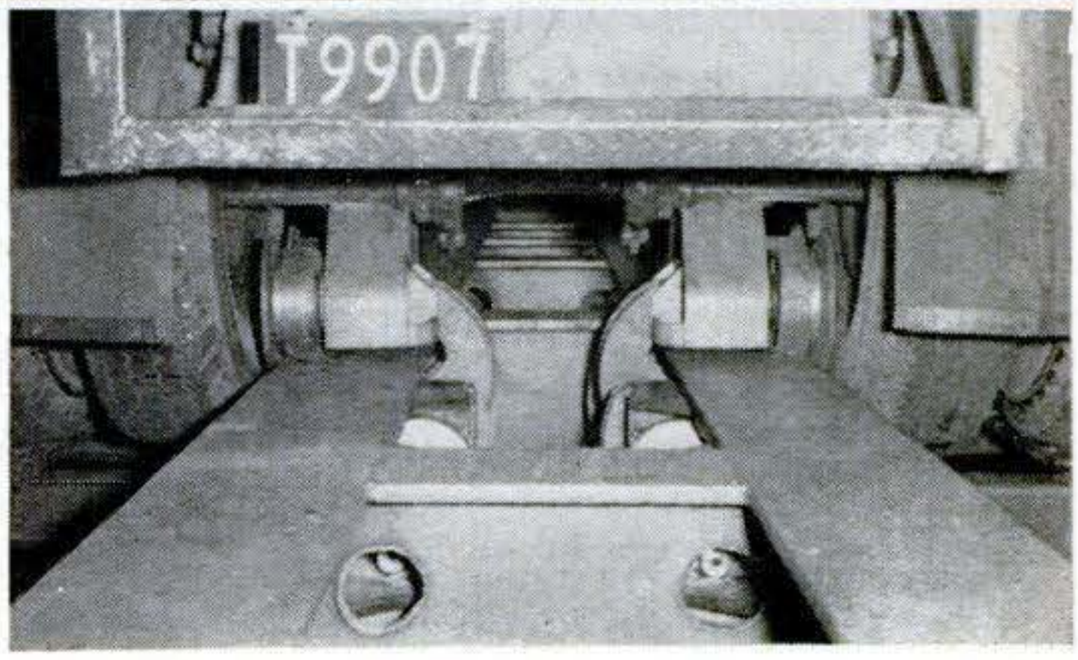
"Aerodynamic" Car Fins Get Smoke Test in Wind Tunnel

To SHOW that upswept rear fins on their 1957 line reduce steering effort in a crosswind, Chrysler officials gave a scale model a whirl in the Detroit University wind tunnel, using smoke as "visible" air. Engineers watch above, behind glass so smoke won't get in their eyes.



Clamp Locks Trailers on Flatcar

DESIGNED to cut handling time and carry two semitrailers—instead of one—this new flatcar will speed rail-highway interchange on the New Haven Railroad. Flatcars are equipped on top with rails and automatic clamps that lock into a dolly device on the trailer axle (right). Flanged wheels of the dolly and at the trailer's front ride the topside rails.



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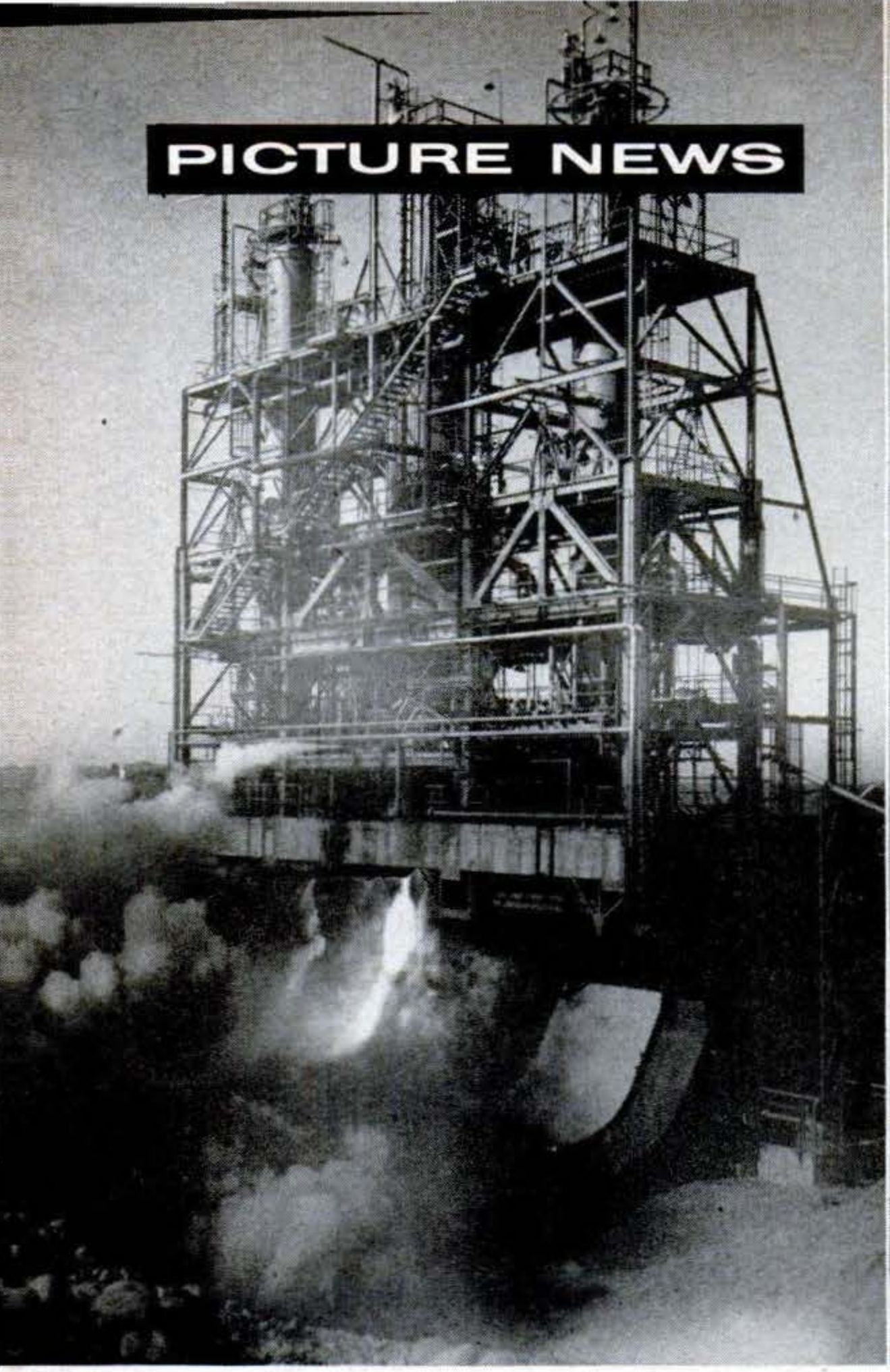

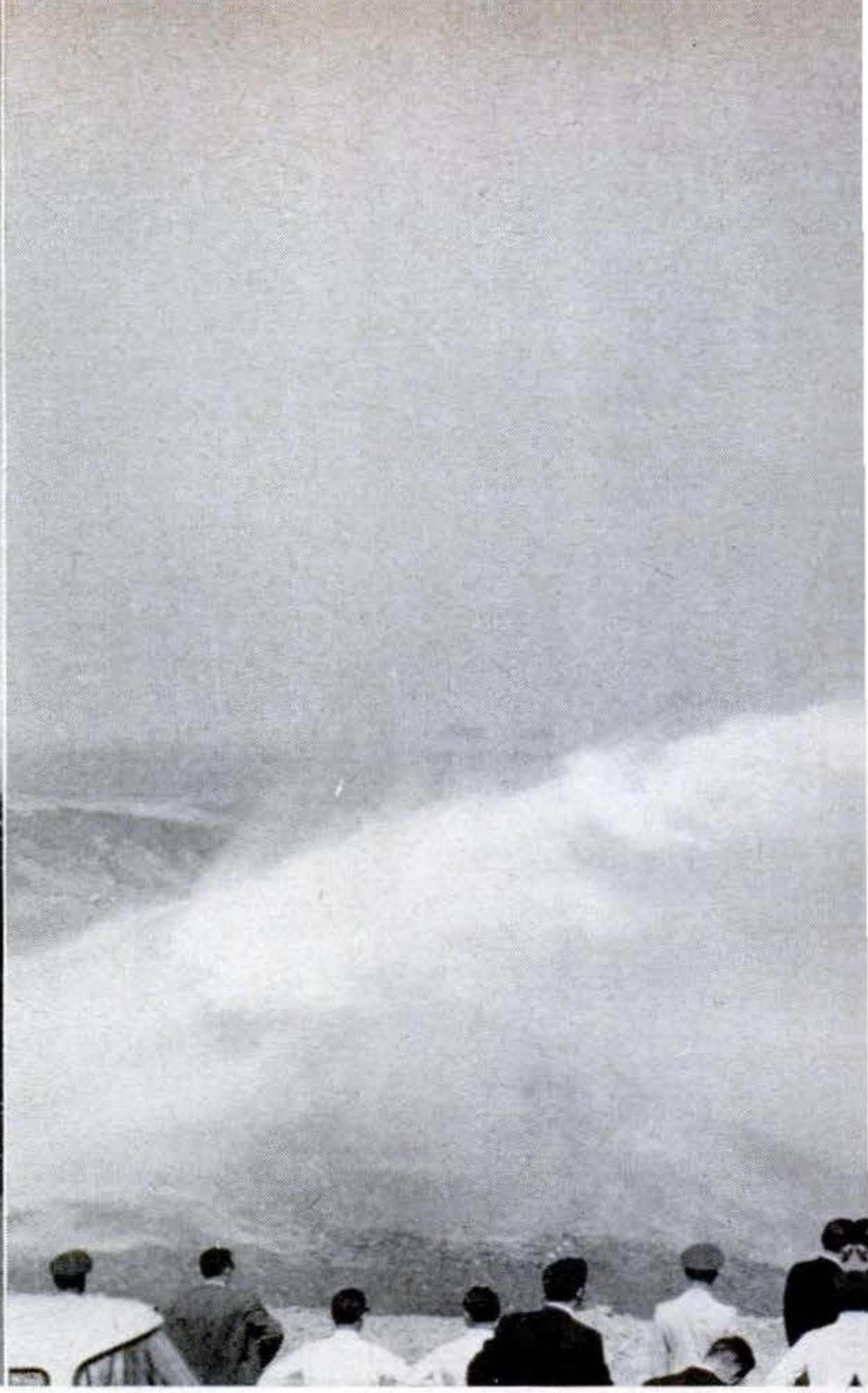

Huge Sweep of Water Protects Test Stands from Intense

So INTENSE is the heat and so great the thrust when rocket engines are tested (left) on these stands, that deflection plates at the bases must be cooled with cascades of water, as at right. Up to 10,000 gallons per minute can be forced through spray holes in the plates at

Italians Build "Dream Bus"—for Today and Tomorrow

THIS all-plastic "dream bus," christened the "Golden Dolphin," is an actuality and ready to roll on either present or future highways. Designed by Viberti, of Torino, for a gas-turbine engine and 125 m.p.h. cruising speed, it gets along now on conventional piston power.

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Heat and Thrust When Powerful Rocket Engines Blast

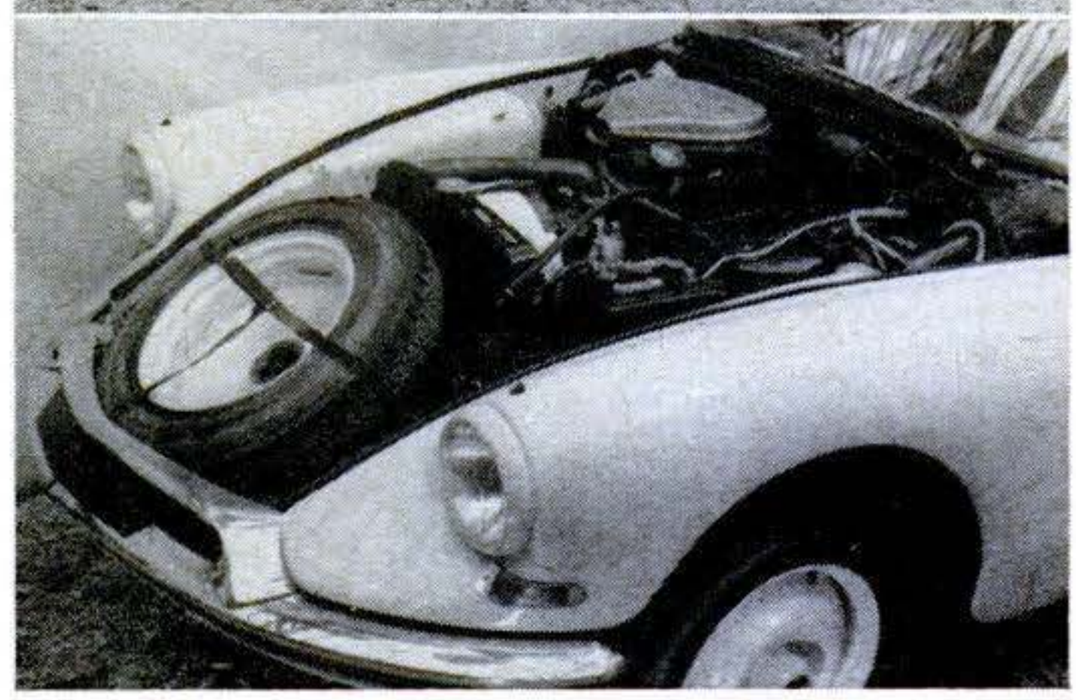
Aerojet-General Corp.'s new rocket-engine testing facility near Sacramento, Calif. The stands, 84 feet wide, 100 feet high and 64 feet deep, handle engines for intercontinental ballistic missiles developing a million pounds' thrust, many times that of a B-52.

Rainproof Loudspeakers Call Drill Steps from Ground

IN THE huge athletic stadium at Prague, ground loudspeakers, like the one being tested with water below, coordinate movement and music for mass calisthenics. Drain holes in the base are covered by an acoustic cone to keep rain out of the system, if not off the Czechs.

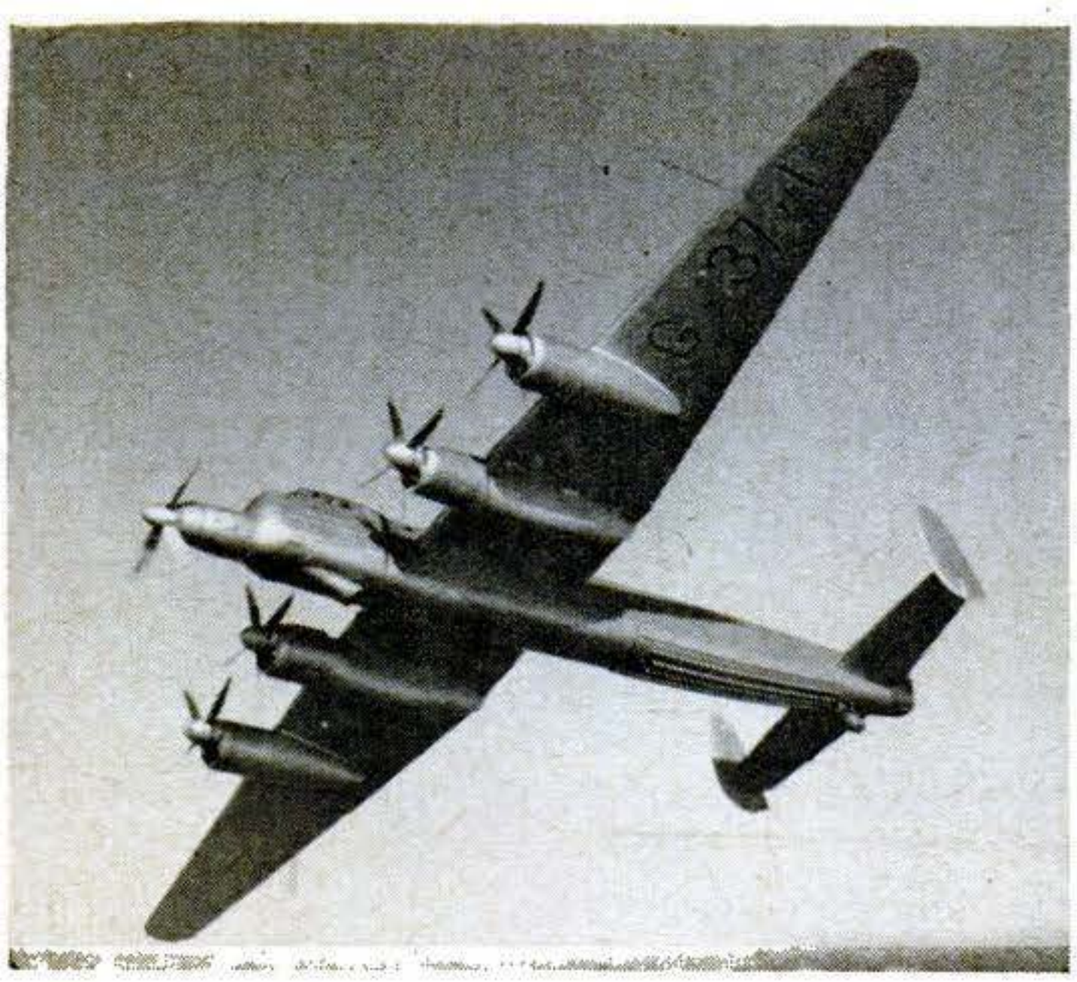
Tower Tests Jets for Copters

RAM JETS for helicopters are put through their paces on this test tower at Langley Field, Va. During night operations, jets at the blade tips of a spinning rotor ring the tower with a glowing halo. The tower is used by the National Advisory Committee for Aeronautics.



Citroen Shows a Budget Model

THIS poor man's version of the French Citroen skips along on 62 horsepower with the same frog nose and translucent roof as its big and more gadgety brother. The smaller engine and the spare tire of this front-wheel-drive car cuddle together under the hood.



Old Bomber Tests New Engine

OLD planes never die—they serve as flying test beds. Witness the World War II Lincoln bomber above nose-hung with a new Rolls-Royce turboprop. Four of the 4,470-hp. power packs will propel the forthcoming Vickers Vanguard, a king-size version of the Viscount airliner.

Spark Arrester Prevents Fires

THAT swirled pipe on the tractor above traps sparks from the exhaust before the gases escape at the center opening. It is for use on any internal-combustion engine at work around dry crops, forests, oil fields or airports. Erickson Products Co., San Francisco, makes it.

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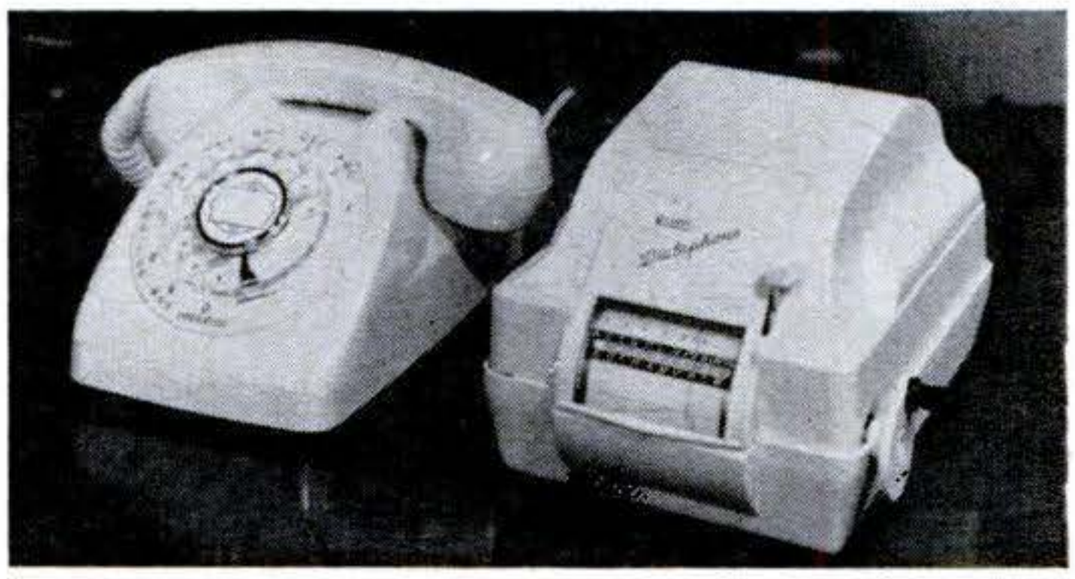
Trainer Spots Piloting Problems of Future Planes

A FLYING machine that never takes off is helping the USAF solve piloting problems of tomorrow's higher- and faster-flying planes. It duplicates vertical and pitching motions, and subjects a pilot to normal accelerations. His reactions are studied as he works the control stick to keep a moving ball aligned on a projected sighting image.



Directory Box Dials Telephone

THIS automatic dialer (above right) puts calls through the standard phone at the press of a button. Made by the James Kilburg Corp., San Mateo, Calif., it can carry 850 numbers on its coded tape.

Mark II Special Drops Its Top

THE first Continental convertible since 1948, this classy Mark II folds away its white-lined orlon top. A special job, it is built only on order by Derham Custom Body Co., of Dearborn, Mich.

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High-Speed Water Jet Torture-Tests Landing Gear

WHEN the water is turned on in this L-shaped contraption, it spews a jet stream that catapults a huge, track-riding carriage at speeds up to 150 m.p.h. in a few seconds, with a thrust of 400,000 pounds. The new National Advisory Committee for Aeronautics device tests the effect of runway impact on airplane landing gear, like that below.

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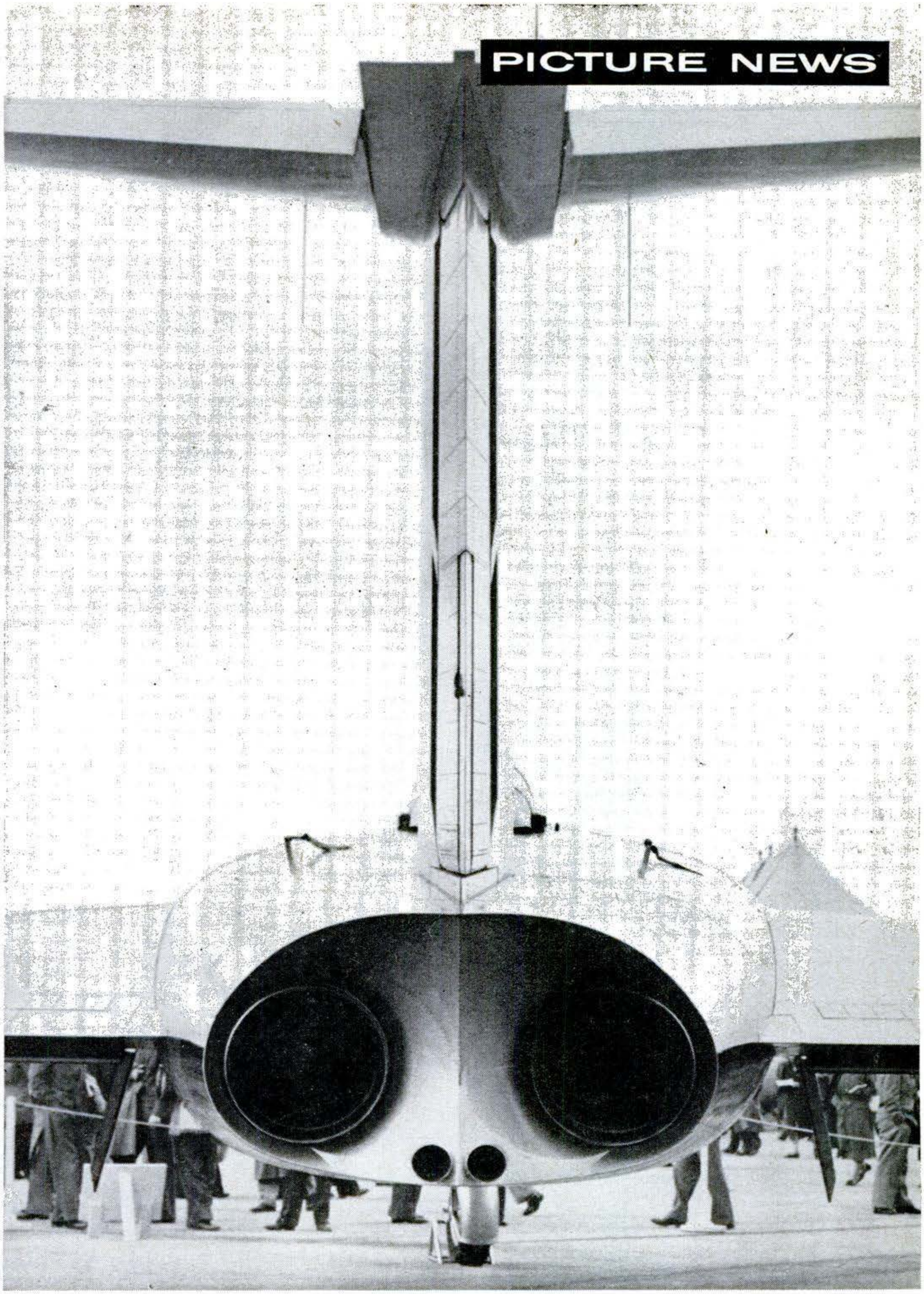

Bug-Eyed All-Weather Fighter Carries Powerful Sting

LOOKING from the rear like a giant insect, Britain's Gloster Javelin can launch guided missiles from 50,000-foot altitudes at speeds over 600 m.p.h. It is also armed with 30-mm. guns and equipped with radar for day and night operation. Two turbojets power the plane.

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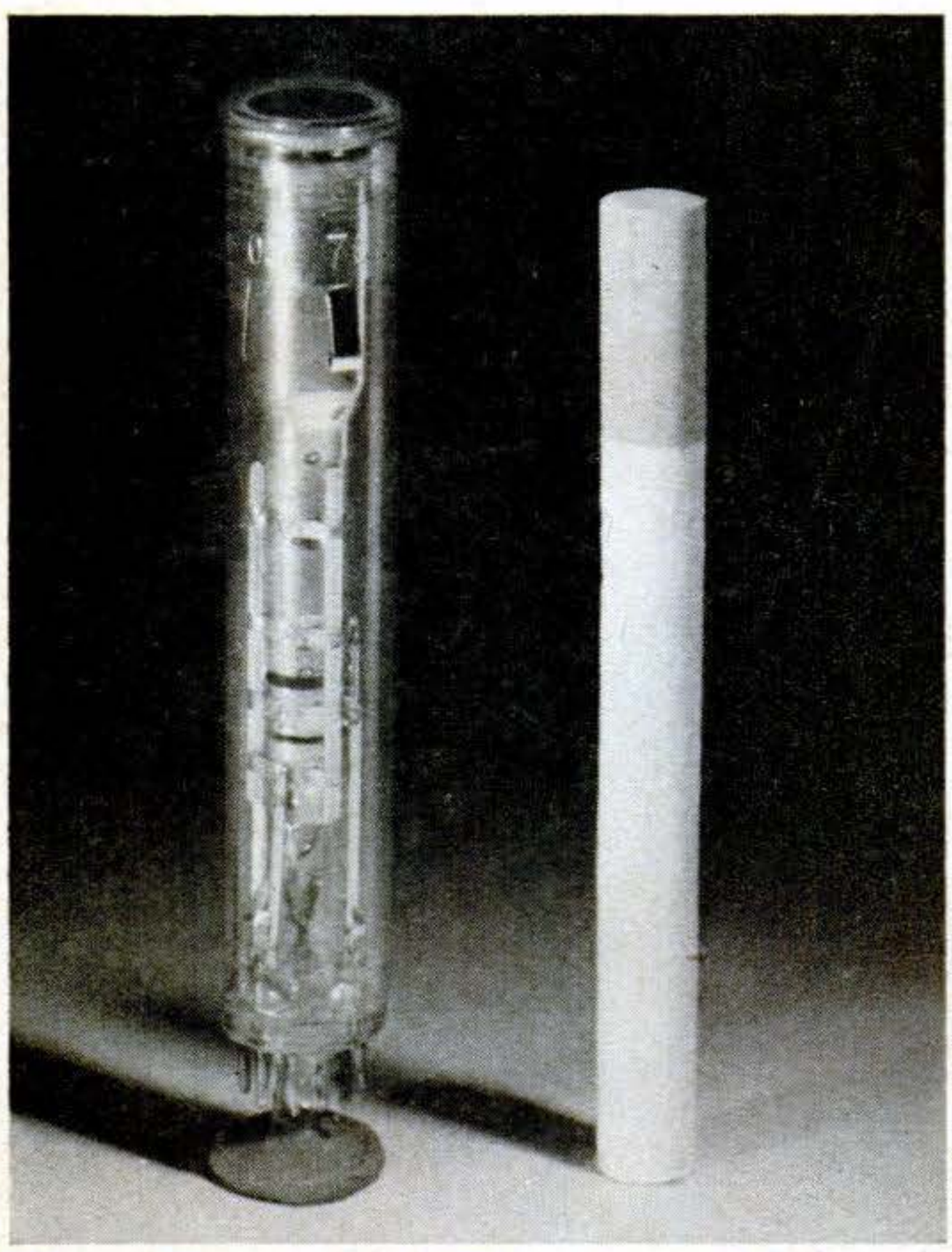
PICTURE NEWS

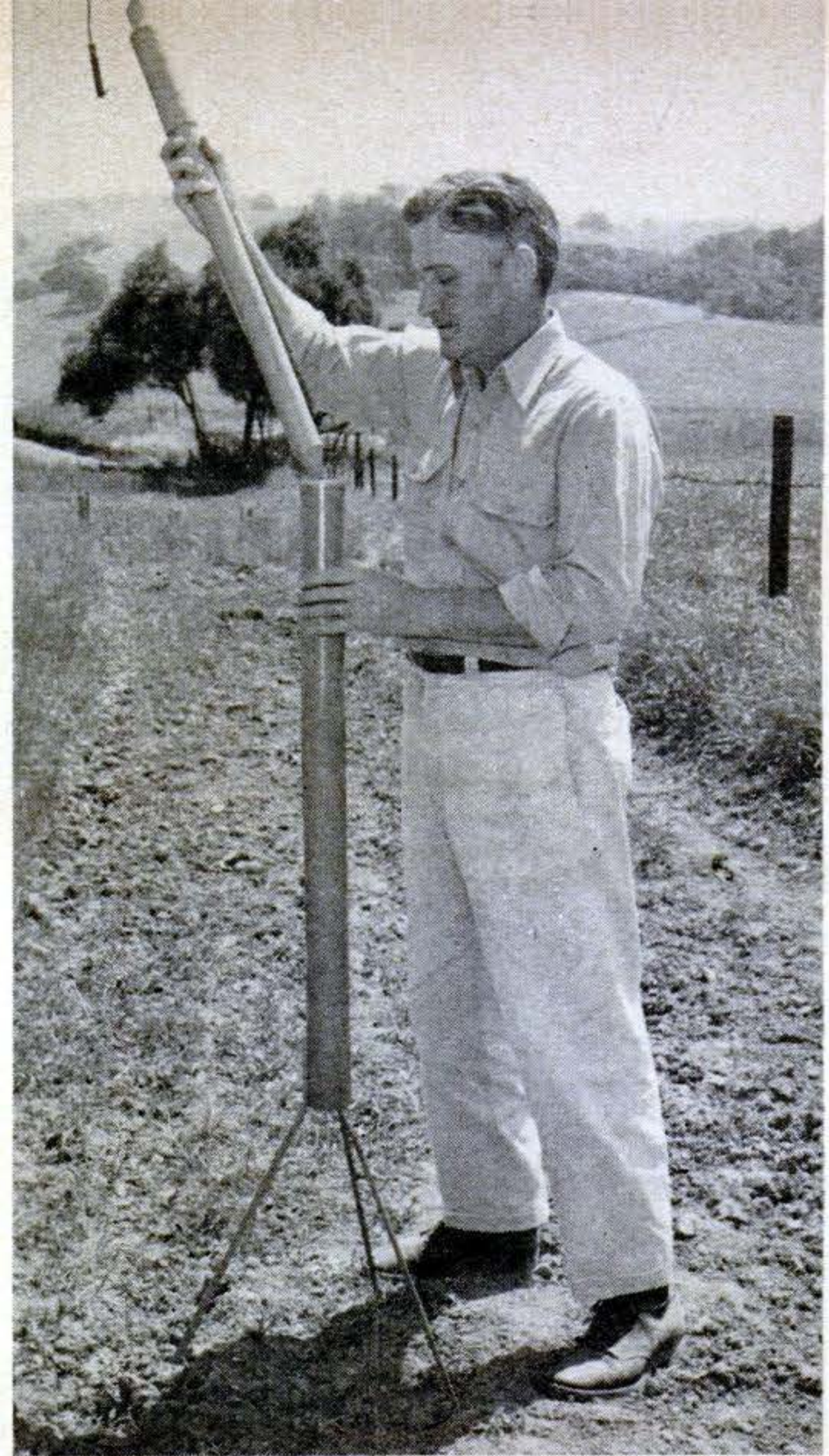
Robot Tractor Knows Its Route

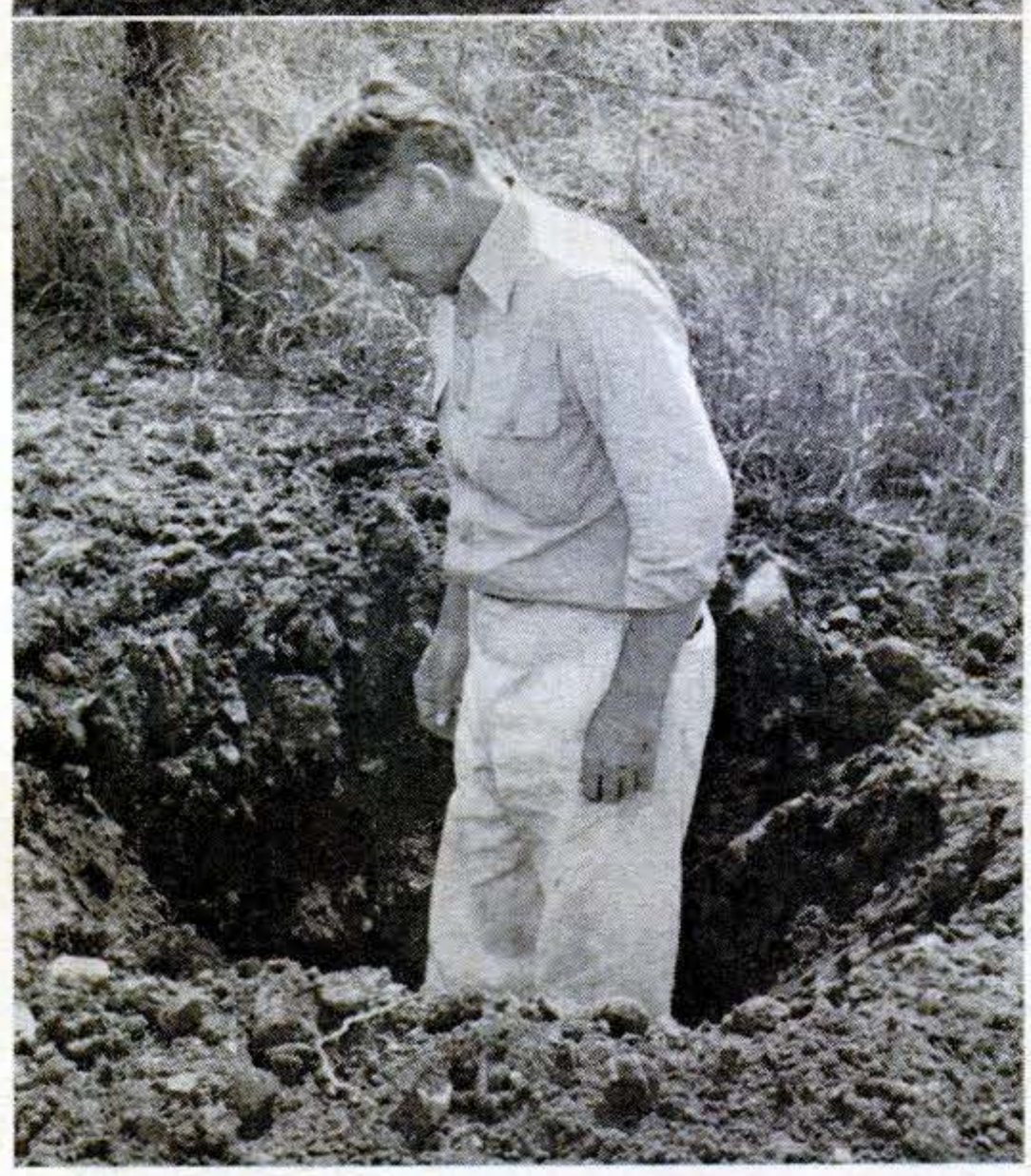
ELECTRONIC signals from a wire in the floor or under tape on the floor are picked up by a receiver in this robot tractor and guide it along its preset routes. Barrett-Cravens, Northbrook, Ill., makes it.



Tiny Tube Has Big Sensitivity

FOR smaller TV cameras using transistors, RCA has developed this miniature Vidicon pickup tube shown beside a cigarette. It's a half inch in diameter, three inches long. Despite its small size, says the maker, it is supersensitive to light.





"Bazooka" May Dig GI Foxholes

THIS fast and easy way for a soldier to dig in is being developed by the Army. In the top photo a rocket unit is inserted in a foxhole-digging device. When it was fuse-fired into the ground, it blasted out the hole shown in the lower photo.

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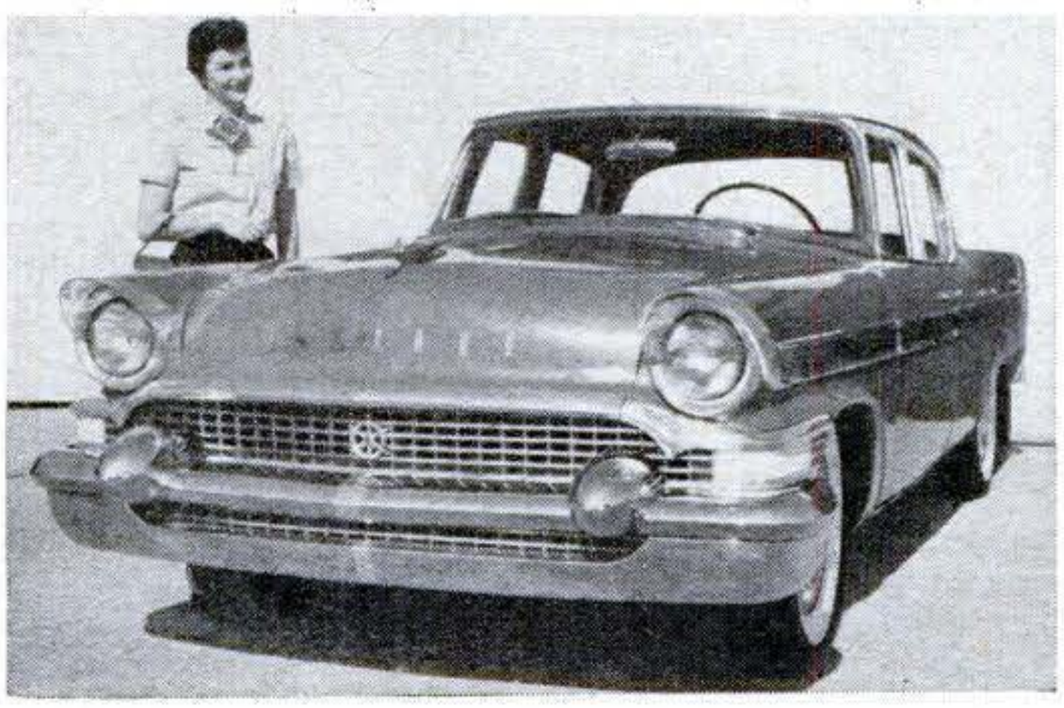
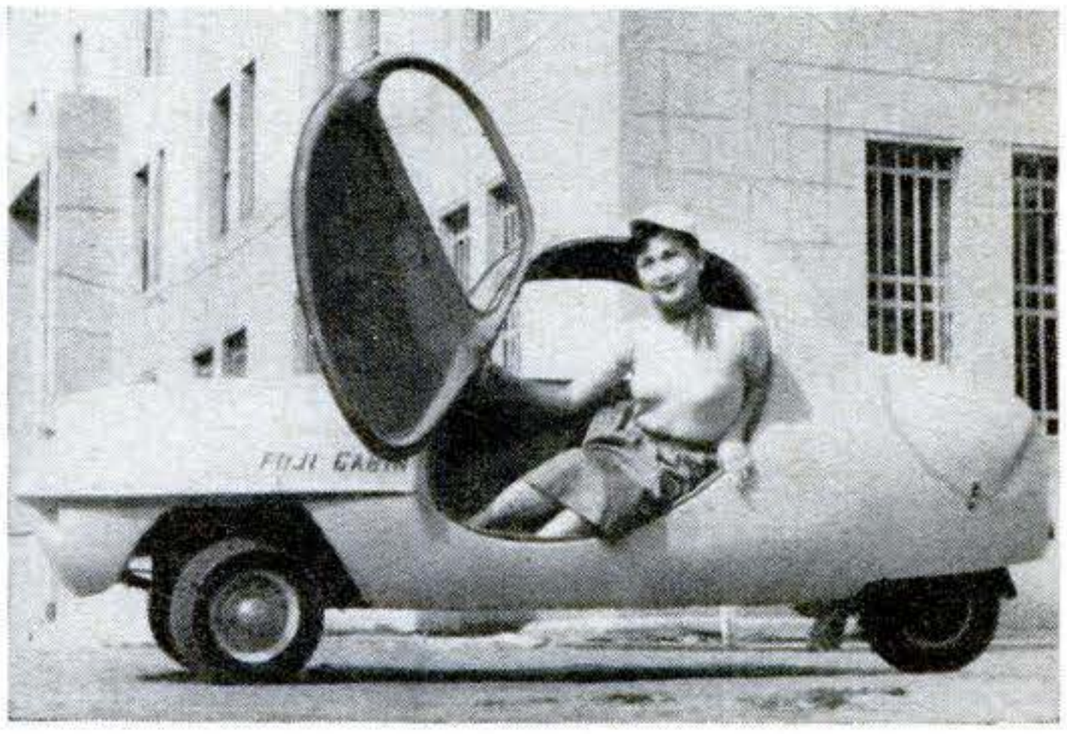
Jeep and Ford Don New Look for Pickup Jobs

CAB up front, well ahead of the engine, gives Willys' new four-wheel-drive Jeep (top photo) more space behind for payload, and offers the driver better forward visibility. The Ford Ranchero, just above, combines luxury lines and more space with rugged construction.



Clipper Claims "New Approach"

THE "new approach" is to the medium-price field, say the makers of the 1957 Packard Clipper, which offers many features of the costlier Packards, including improved acceleration, greater length, and wall-to-wall carpeting.



Three-Wheeling Through Tokyo

JAPAN soon will see more of this two-seater cabin scooter that Fuji Motors is putting into production. Carrying a plastic body, it has a 5½-hp., one-cylinder, air-cooled engine and a top speed of 37 m.p.h. Price is estimated at $610.

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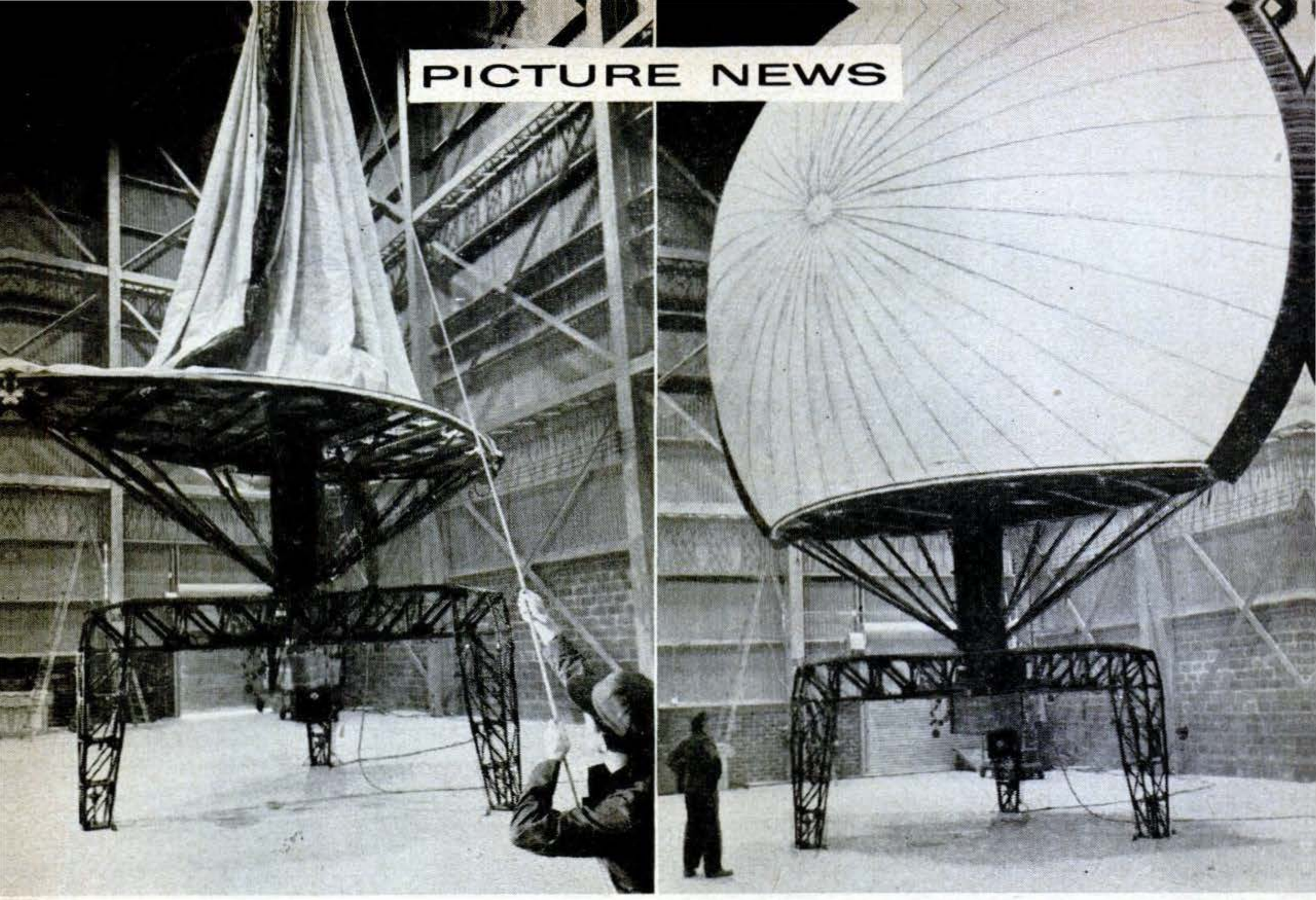
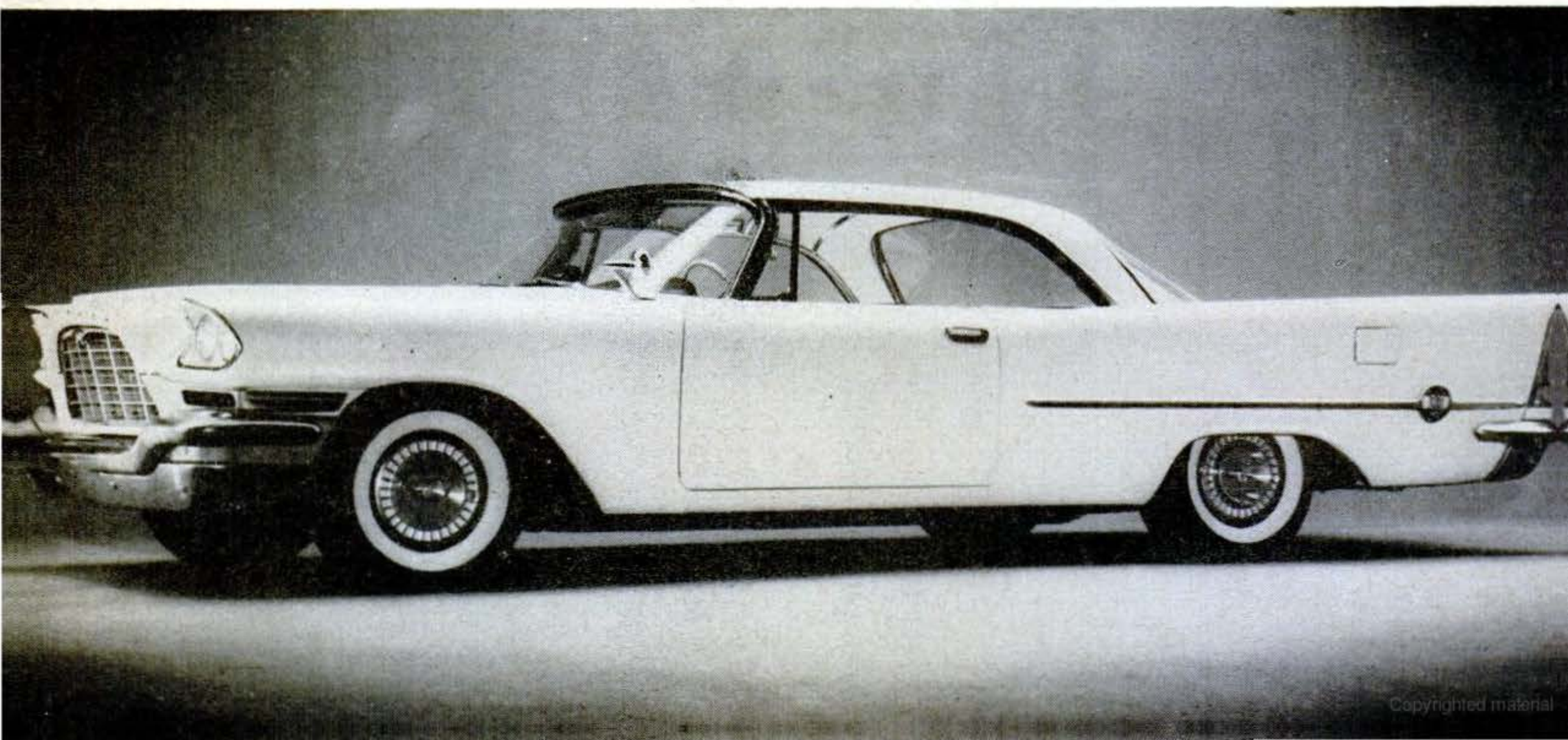


Portable Radar Units Can Be Set Up in Minutes to Provide

THE collapsible 30-foot "lollipop" balloon above is a fiberglass radar antenna, designed for air-dropping in tactical areas to detect enemy aircraft; on the facing page is the world's smallest radar—it's for carrying by ground troops. Both are the latest developments in lightweight, battlefront radar protection. Westinghouse designed the infla-

Chrysler's New Big "300" Tops Record with 375 Hp.

CHRYSLER leads the 1957 horsepower race with its new "300" sports car—its V-8 produces 375 hp. at 5,200 r.p.m. Standard compression is 9.25:1, and even greater power (unspecified) is available at 10:1. A convertible coupe is included in the line for the first time.



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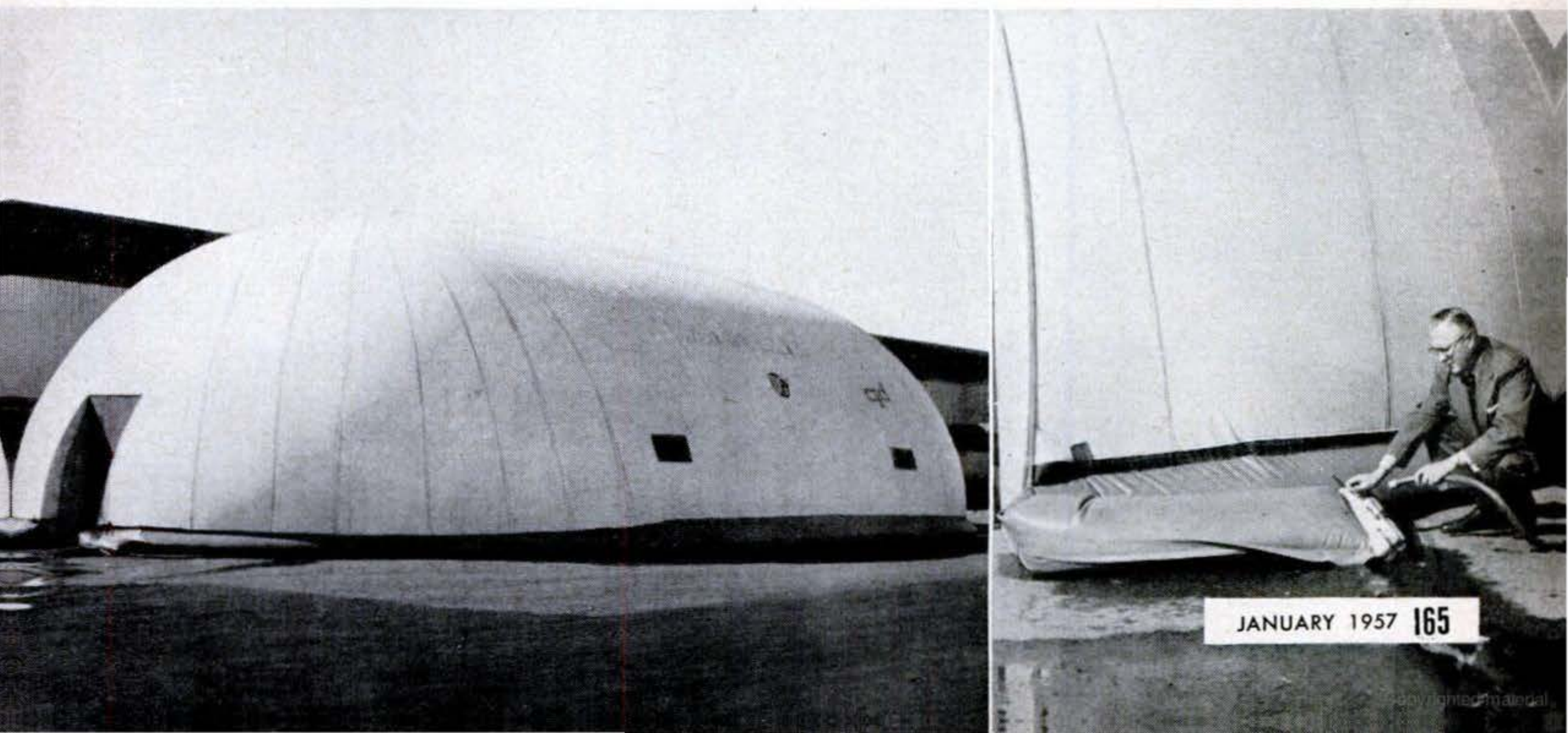
Air Force and Army with "Eyes" Far from Main Bases

table parabolic antenna for the Air Force. It weighs less than a ton, and can be taken apart and packed quickly in air-lift cases. The little Army device, developed by Sperry in cooperation with the Signal Corps, doesn't use a heavy "blip" cathode-ray tube. Instead, probing through smoke, darkness or fog, it sounds off at any movement inside 6,000 yards.

Water-Anchored Portable Warehouse Supported by Air

INSTEAD of using struts, this building is held up by air from a blower that maintains constant pressure. Made of U.S. Rubber vinyl-coated nylon fabric, the 400-pound warehouse can be erected in an hour. Water in a built-in tube (right) in the base anchors it to the ground.



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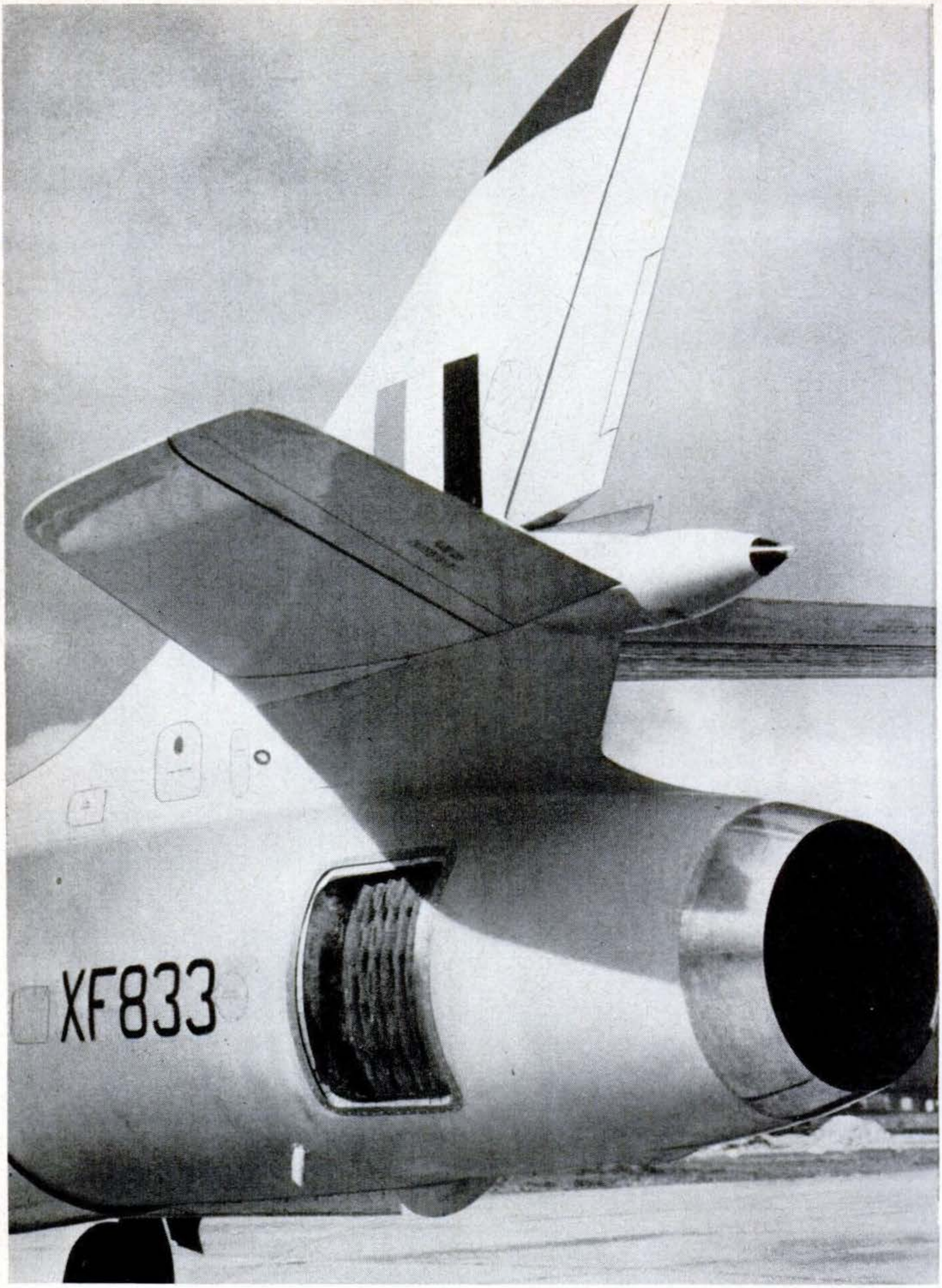

Exhaust Baffles Reverse Thrust to Stop Jet in Hurry

SHUTTERED windows on the sides of the Hawker Hunter's tail cut landing distance of this British jet fighter in half. In flight, the vertical "Venetian blinds" seal the two openings; in braking, they are pivoted rearward to block the tailpipe, deflecting gases out the sides.

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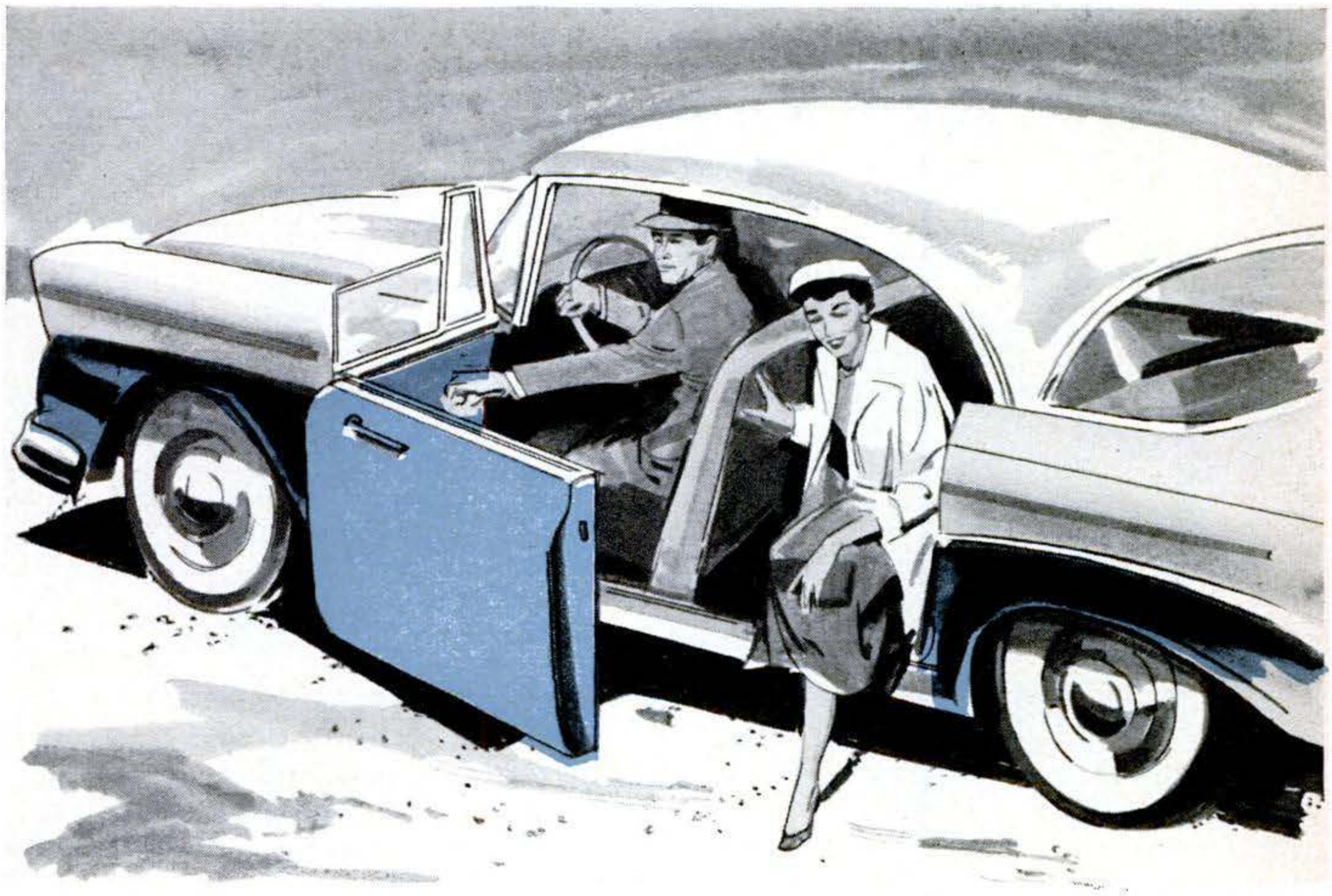
New Ideas from the Inventors



1 Folding Door to Ease Entry. Rear-seat passengers could get in or out of this two-door car without having to dislodge the driver or tilt the front seat. Opening out elbow-fashion, the double-hinged door would widen the entry while keeping total door span within the limits of cramped parking spaces.

2 Ring to Make Pin Swallowproof. Even a hungry infant would have trouble downing this outsize, circle-surrounded safety pin. Formed across the center of a large metal or plastic ring, the pin would be too large to swallow and less likely to open accidentally.

3 "Shingle" to Melt Roof Ice. This shingle-shaped roof attachment, enclosing an electric heating cable, would keep a roof edge free of snow and ice. It would eliminate the danger of falling icicles, and help prevent storm-driven moisture from seeping under shingles.

Please turn the page for more new ideas

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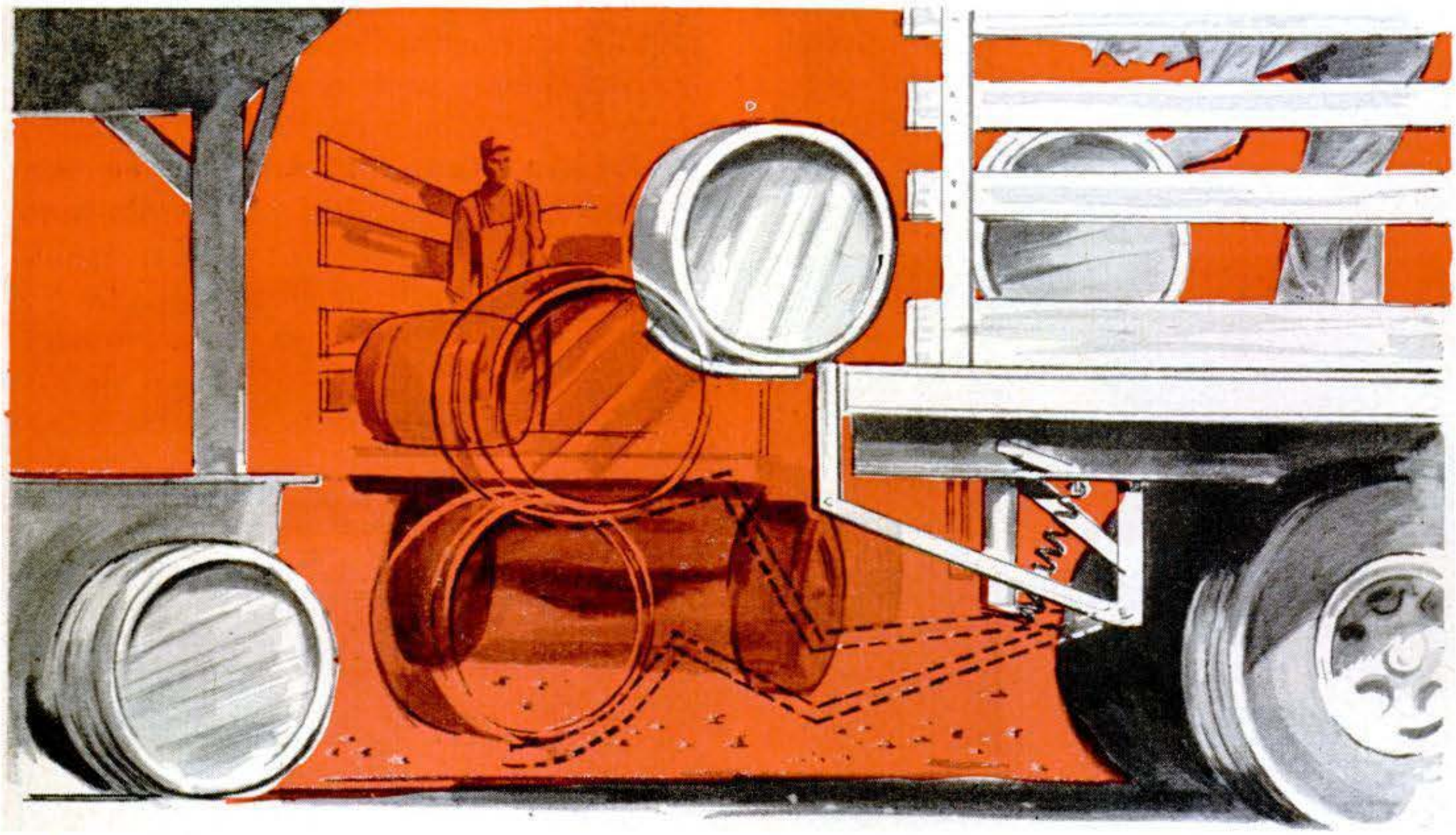
More Inventors' Ideas

4 Clip to Sharpen Pencil. You'd never have to hunt for a well-pointed pencil if you had a combination clip and sharpener like this. The slide-on pocket clip would keep the pencil handy, and the slide-off sharpener would always be available for repairing the point.

5 Tape to Skidproof Shoes. If you were caught in an ice storm that made streets dangerously slick, applying these grit-backed adhesive strips to your shoes would give you a surer, safer footing. The anti-skid tapes might be dispensed, in season, by vending machines.

6 Spring Saddle to Unload Truck. The counterbalancing spring on this cradle-shaped tailgate might ease the job of unloading barrels or drums. A freight handler would roll a drum onto the cradle, which would then lower itself, discharge the drum, spring up for a refill. Spring tension would be adjustable.



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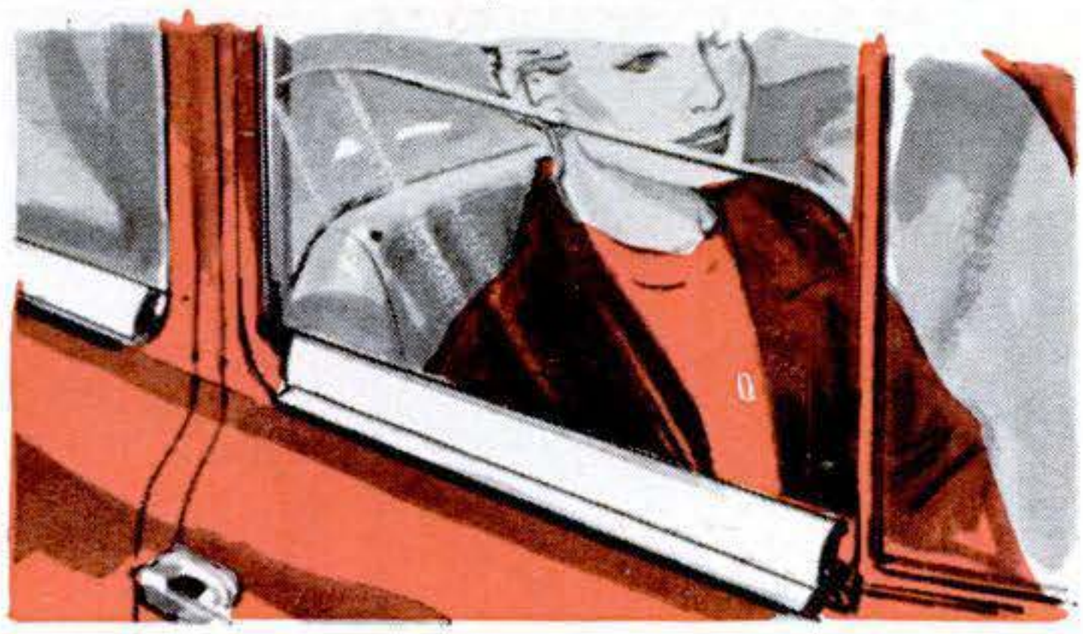

7 Armrest to Wipe Car Window. This weatherstrip attachment would keep rain out of a car-window slot, help to prevent rattles, and would wipe the glass as you rolled the window up or down. When the window was all the way down, it would become an armrest.

8 Jig to Feed Work Into Saw. Designed to ride along the fence of a circular saw, this stock feeder could be adjusted to grip boards of different widths and thicknesses. The device would enable you to keep your hand safely out of the way while pushing the work firmly and evenly into the sawblade.

9 Fishing Tent to Slide Over Ice. Knocked down, this collapsible tent-pack would fit easily into a car trunk. A hunter or ice fisherman could drag it to a selected site on its sled-like runners, then quickly set it up for use as a shelter on its hinged, preformed base.

The following patents *have been issued on these inventions: 1. Patent No. 2,743,773 to Axel H. Weirtz, Malmo, Sweden; 2. No. 2,731,692 to Steven J. Steven, Brookfield, Ill.; 3. No. 2,699,484 to Herbert L. Michaels, Sault Sainte Marie, Mich.; 4. No. 2,708,905 to Arthur E. Randall, Huron, Ohio; 5. No. 2,732,065 to Andrew S. Marchese, Brooklyn; 6. No. 2,703,656 to Aubrey R. Banks, Woodside, Calif.; 7. No. 2,690,350 to Clarence M. Shapiro, Chicago; 8. No. 2,696,852 to Hollis C. Dunton, Smyrna, Ga.; 9. No. 2,717,160 to John B. Schmidt, Minneapolis, and Harold J. Hanson, St. Paul, Minn.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

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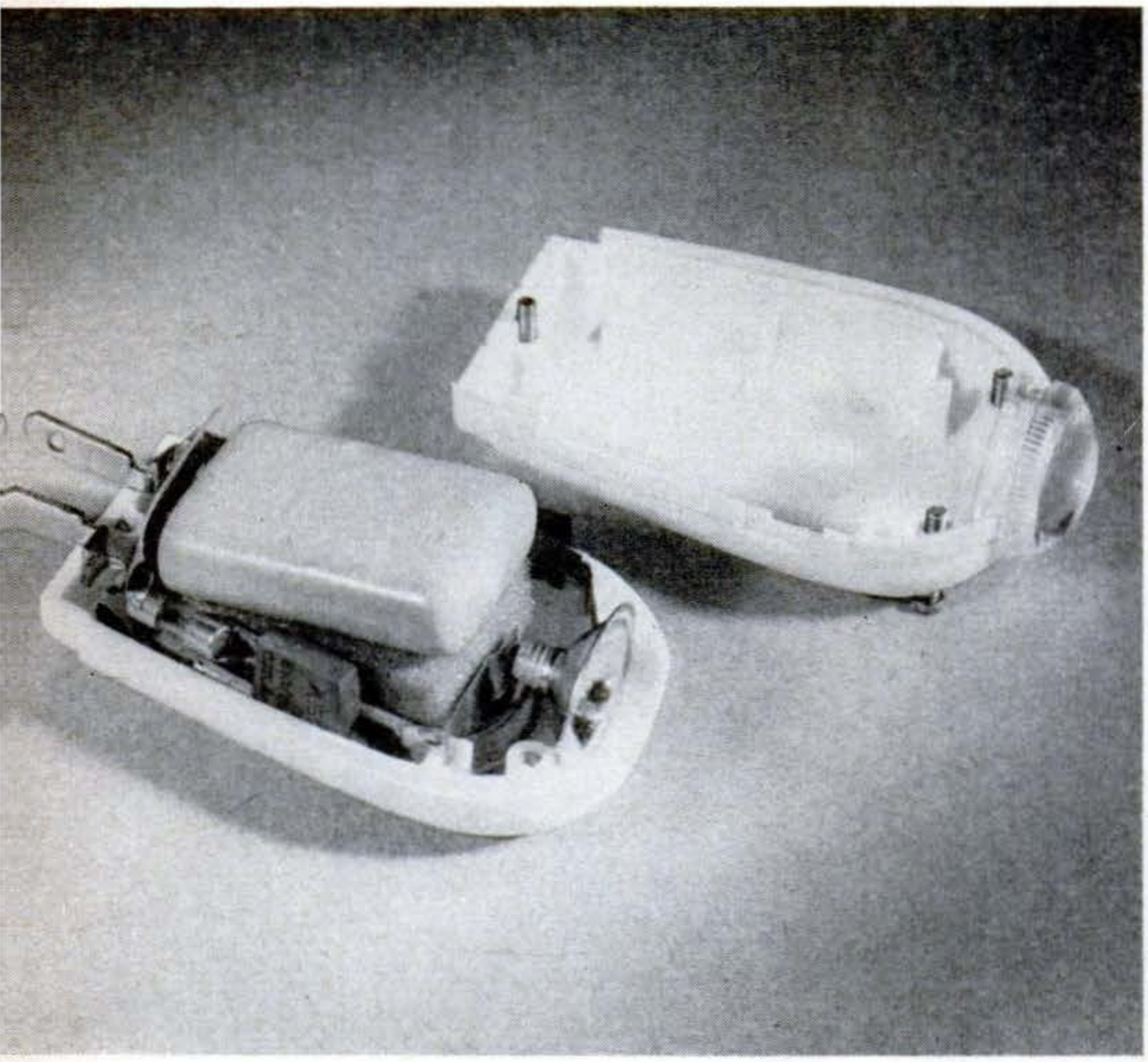
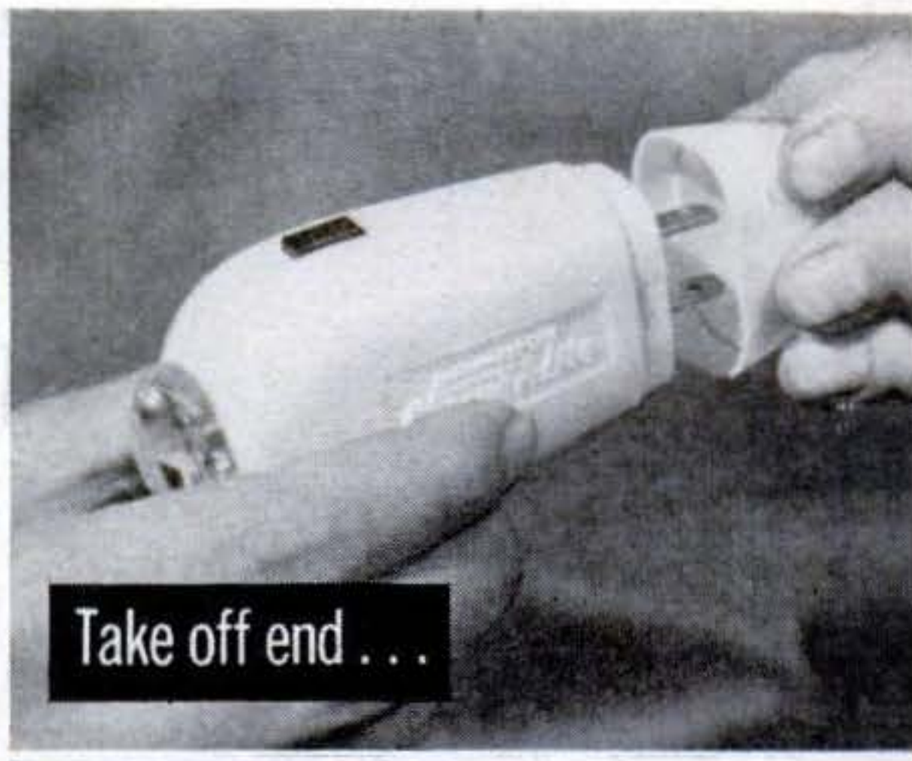
New Aids to Living





1 Rechargeable flashlight is equipped with a 2½-volt nickel-cadmium battery that should last indefinitely if you keep it fully or partly charged. To recharge, you remove the end cap, as above at right, and plug the exposed prongs into a 115-volt AC outlet. In ordinary use, recharging a half hour or so every couple of days does the trick (it can't overcharge). One end of the built-in battery is visible at left under a plastic-sealed condenser and plastic-sponge cushion.

2 Channel switcher adds remote control to any TV set and requires no wiring job. You just replace the set's tuning knob with a motor-driven tuner hitched to a palm-size channel selector on a 20-foot cord. Flashlight batteries run the tiny motor that operates the tuner.

3 Anchored decapper hidden under a shelf or cabinet is never mislaid. To open a jar or bottle, you slide the cap between narrowing tracks that grip it tightly, leaving you both hands free to twist or lift it off. The opener handles screw caps, vacuum tops and pry-off lids.

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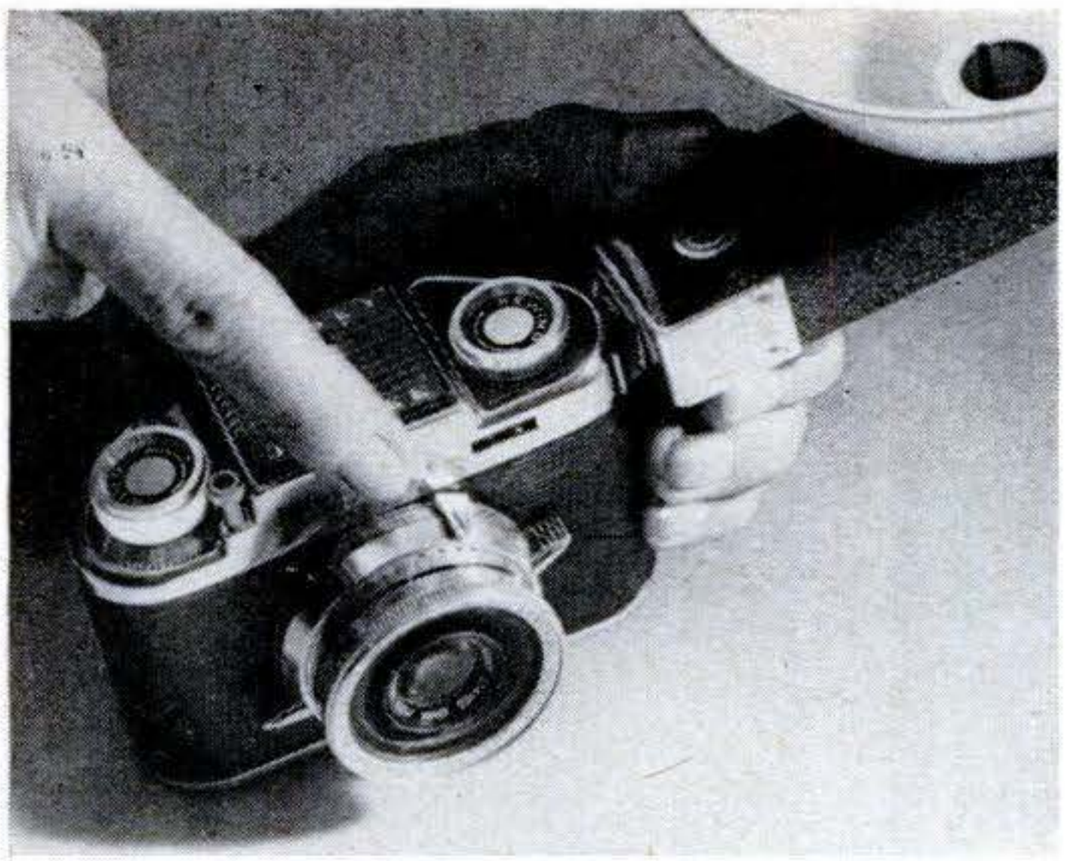
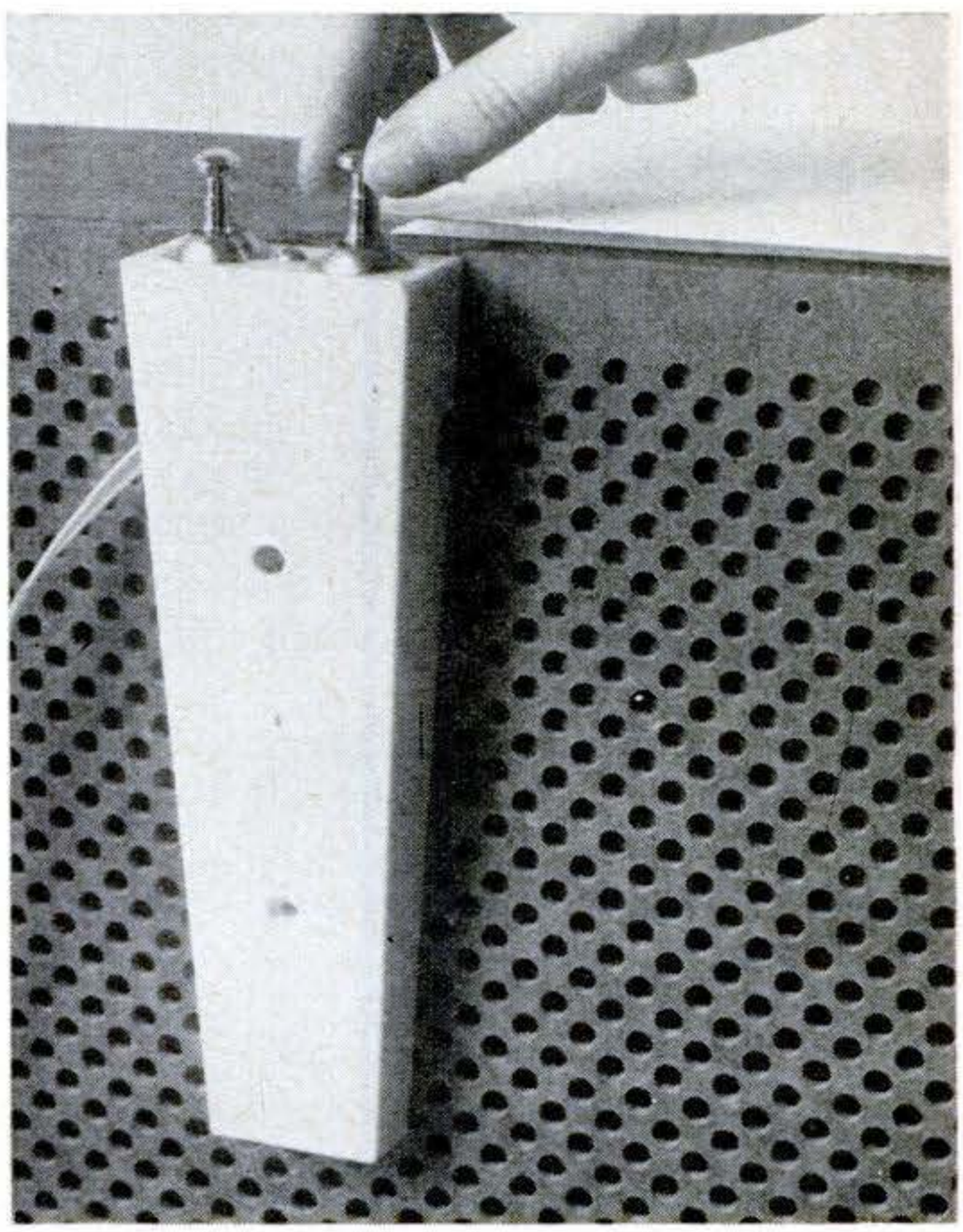


4 Automatic diaphragm control calculates correct exposure for indoor flash on this Bolsey 35-mm. camera. Set the unit once for film and bulb used; then a built-in range finder adjusts the stop for any distance change. The flash gun will swivel to provide bounce light.

5 Clamp-on watch fits on a telephone dial so that plane-catching businessmen or cake-baking wives can check the time as they talk. There's a sweep hand to tick off the seconds and a luminous dial that glows in the dark. Tel-Time will run 30 hours on one winding.

More information *about the products shown on these pages can be obtained from: 1. Remington Rand Electric Shaver, 60 Main St., Bridgeport 2, Conn.; 2. Alliance Mfg. Co., Inc., Alliance, Ohio; 3. White-Horn Co., 588 N. Larchmont Blvd., Los Angeles 4, Calif.; 4. Obex Corp. of America, Lynbrook, N.Y.; 5. Alexander-Benwood & Co., 16 Court St., Brooklyn 1, N.Y.; 6. Cheslam Corp., 684 Nepperhan Ave., Yonkers 2, N.Y.; 7. JFD Mfg. Co., Inc., 6101-16th Ave., Brooklyn 4, N.Y.*

6 Cream by the bagful will cut down dishwashing in homes and restaurants. Tearing off a corner of the plastic bag opens a controlled-flow spout. Because cream won't pour out unless the pouch is tightly squeezed, a partly empty one can be set aside without spilling.



7 Disappearing antenna telescopes its rabbit ears when not in use to stow them in a receptacle fastened to the back of the TV set. Lifted, the dipoles pivot full circle on ball sockets. The fixture comes with dipoles that range in extension from 7¾ to 54 inches.

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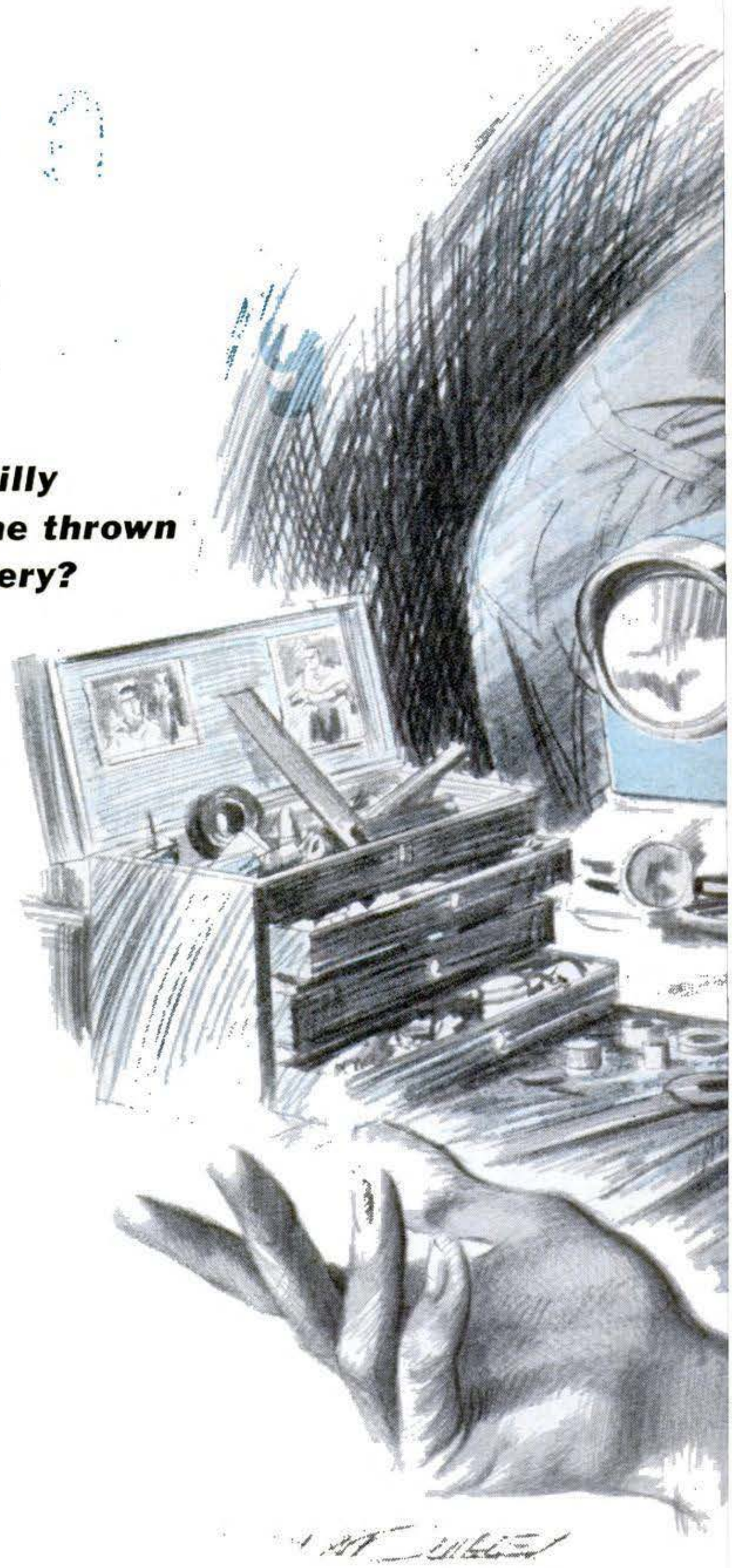

Was it carelessness that caused Billy Wells' car to stall? Or had someone thrown a monkey wrench into the machinery?

By Martin Bunn

GUS folded the letter and put it back in the envelope. He regarded Stan Hicks, his capable assistant, with a doleful expression.

"Man the battle stations!" he announced. "Batten down the hatches. My sister's son is going to visit us again."

Stan, visibly shaken, sat down on an oil drum. "You mean—Lister?"

"The same."

"I remember his last visit," Stan said with a tremor in his voice. "Does he still think he's a mechanical genius?"

"That was three years ago," Gus said. "By now he's probably promoted himself."

"He would be 18, now," Stan mused. "Maybe he's outgrown all that."

Gus tapped the letter. "He's arriving in a hot-rod he souped up himself, it says here."

"Why not tell your sister that you're too busy and that Lister gets in the way?" Stan asked.

Gus sighed. "I wish I could, but I just don't have the heart. She doesn't know how to handle him. Since his father died, he's been even more of a problem. She says a visit with me will be good for him —and for her. I can't turn her down."

"Too late, anyhow," Stan said, as a shriek of tortured tires announced the arrival of a chopped-roof jalopy. "Lister the Blister is with us."

An undersized youth with long hair combed to a duck tail in the back oozed out of the heap and slouched toward them. He glanced scornfully about the Model Garage. "This place is just as crumby as ever. Looks like you could use me around here."

"Certainly can," Gus replied. "We need somebody to change oil, grease chassis and wash cars. We—"

"I don't mean that kind of work," Lister broke in. "I want to work on engines. You ought to have some new blood in your business. What do you say, Unk?"

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"You're getting careless, Unk,"
Lister cracked. "You overlook little things."

"We'll see," Gus temporized. "If you can prove yourself, we'll use you."

FOR the first two or three days, Gus's nephew kept pretty much out of their hair. He did the routine jobs he was asked to do without much complaining. Then one day Billy Wells came in for a tune-up job.

"Want me to take care of it, Gus?" Lister asked with a self-confident smile.

"I'll handle it," Gus told him shortly, wondering as he did if he were being quite fair to the boy.

"Needs a car wash," Billy said. "Maybe you could—"

"A pleasure," Lister replied sarcastically. "I'm working my way up in the business," he explained to Billy. "After I've pulled them out of a couple of tough

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spots, maybe they'll believe I'm as good as they are."

After Gus had put in a new set of points, a new condenser, four new spark plugs and adjusted the timing, he turned the car over to Lister.

"And don't forget to clean out the inside," he reminded the boy. "That goes with the wash."

"Yes, sir!" Lister was wearing an enigmatic smile.

Stan took Gus aside and murmured, "I don't like it when he's agreeable."

"He can't do any harm just cleaning the car," Gus protested. "Look at the way he's going over the front seat. He's even getting after the dirt up under the dashboard."

"I was beginning to think we'd never find a place to park."

BILLY Wells called for his car that afternoon and drove it away. Fifteen minutes later, the phone rang. Stan took the call. As he listened, his face began turning red. He nodded a couple of times and tried to say something, but the person on the other end wouldn't let him. Finally he was able to get out: "Okay, Billy, okay. We'll be right down to take care of it. Well, I'm sorry, Billy. I can't imagine what happened. Yes. Right away."

He turned to Gus and Lister, who were standing in the doorway.

"Billy Wells. Something wrong with the tune-up job. Coughed and sputtered all the way home. Now it won't start."

Gus took a long puff on his pipe. "Well, I'll be—"

Lister grabbed a wrench and headed for his jalopy.

"I'll take care of it," he called over his shoulder.

Stan hollered at him, "Wait up! Me or Gus will take care of—" But with a screech of rubber, the jalopy took off.

"What do you make of that?" Stan demanded.

"I'm not sure," Gus said thoughtfully.

IN A few minutes Lister was back and right behind him came Billy Wells, beaming. "Works like a charm, now," he said. "That boy is a real wonder. Glad you have him working for you."

When Billy had gone, Gus confronted Lister. His face was serious. "What was the matter with Billy Wells' car?"

His nephew laughed. "I just tightened a couple of nuts here and there. That's all it needed. Ask the man if you don't believe me. Your trouble," he continued, spurred on by victory, "is that you're getting careless, Unk. You overlook the little things." Jumping in his hot-rod, he drove off.

"Maybe I have been careless," Gus replied, a funny look in his eye. "Think I'll just keep an eye out for details a little more in the future."

The next morning Mrs. Chambers came in to have her car's idling speed set up. After Gus had taken care of it, Mrs. Chambers backed the car up to a pump and Lister filled her tank. He was very busy and very attentive. When he was done, Mrs. Chambers handed him the money.

Gus said, "You ring it up and bring her the change." Lister looked surprised.

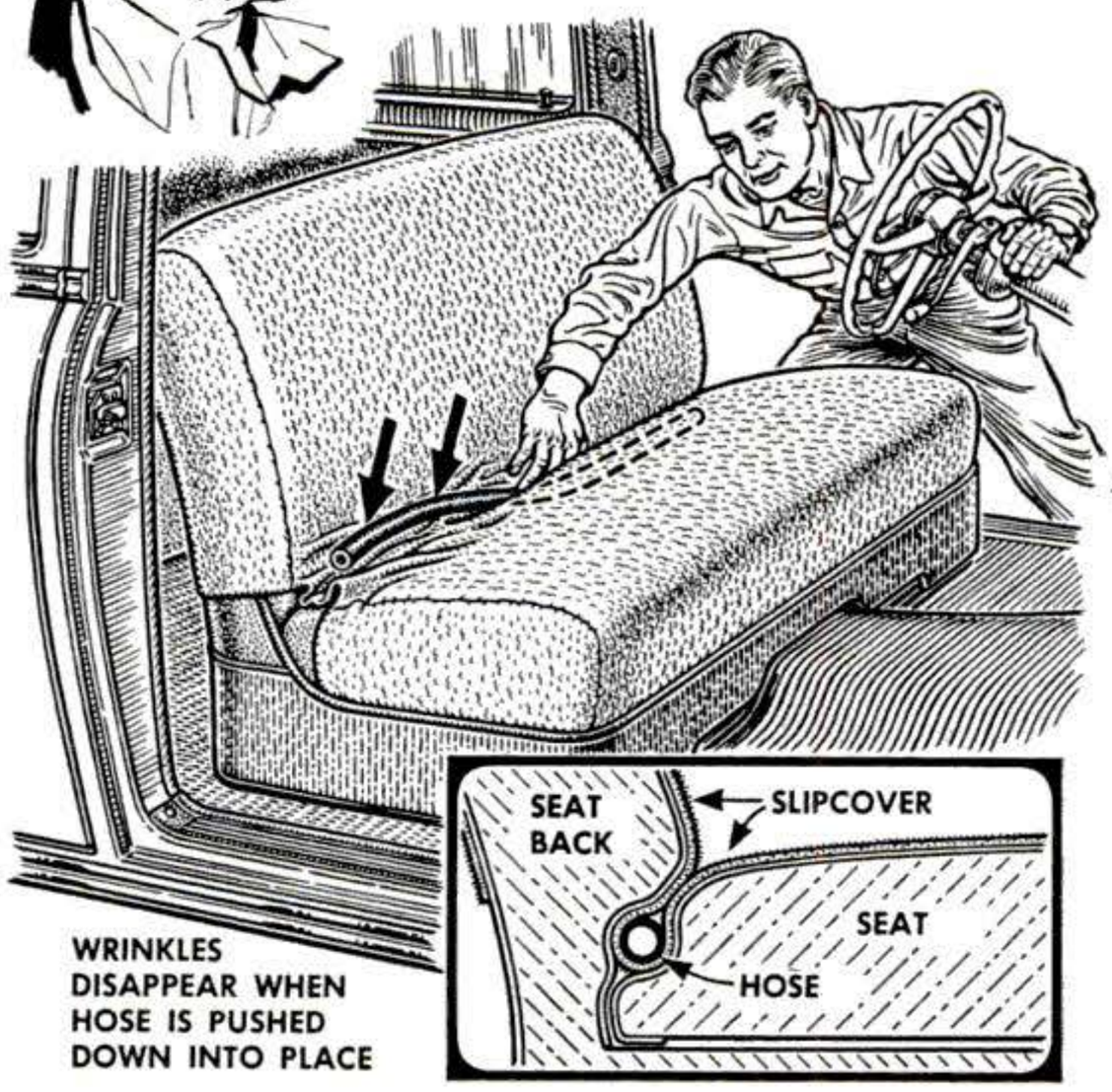
"Sure you trust me?" he asked.

"I trust you with the money," Gus replied evenly.

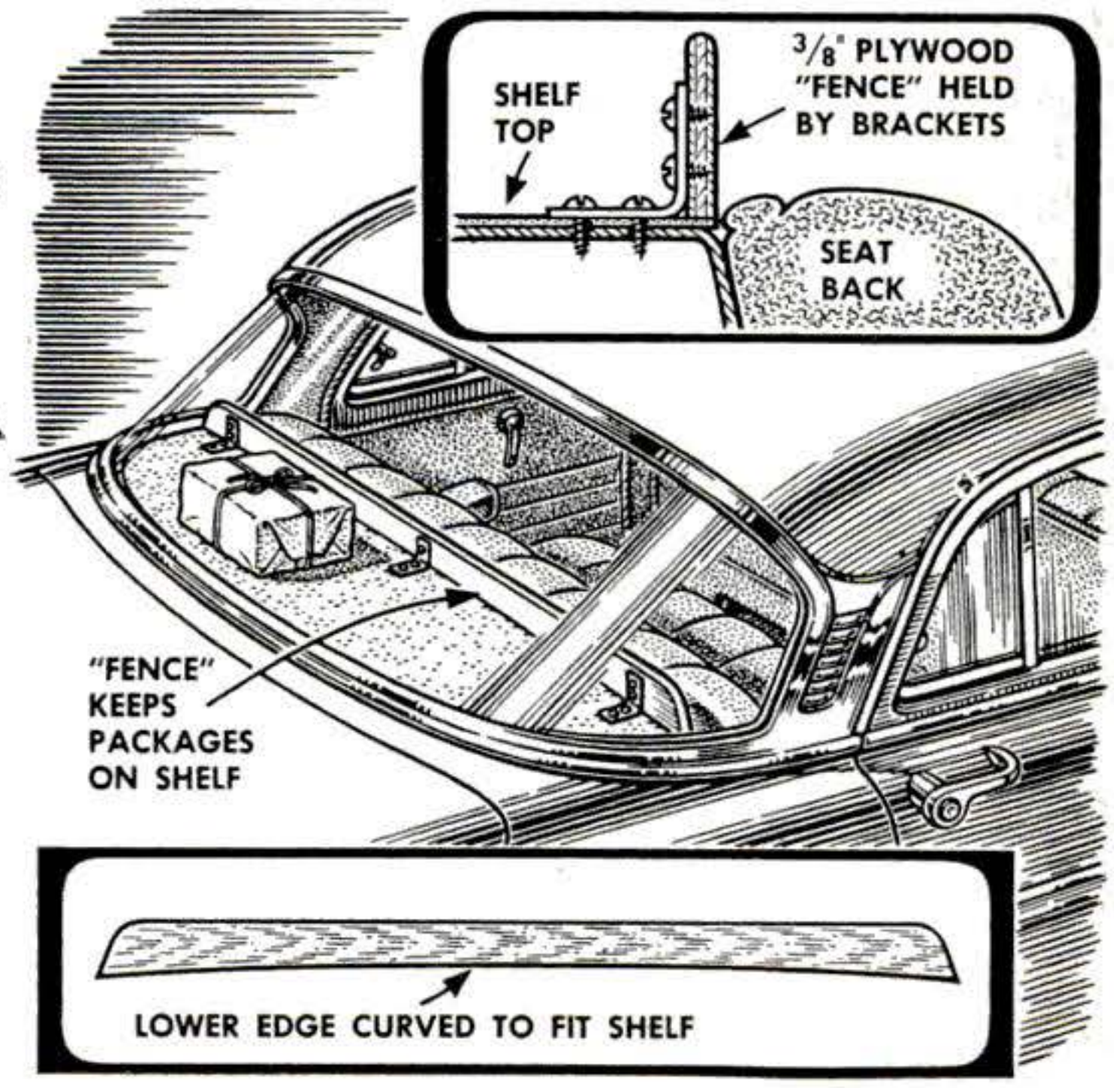
While the boy was inside, Gus walked quickly to the back of Mrs. Chambers' car. His practiced eye took in every detail. Suddenly he saw something very

[*Continued on page 234*]

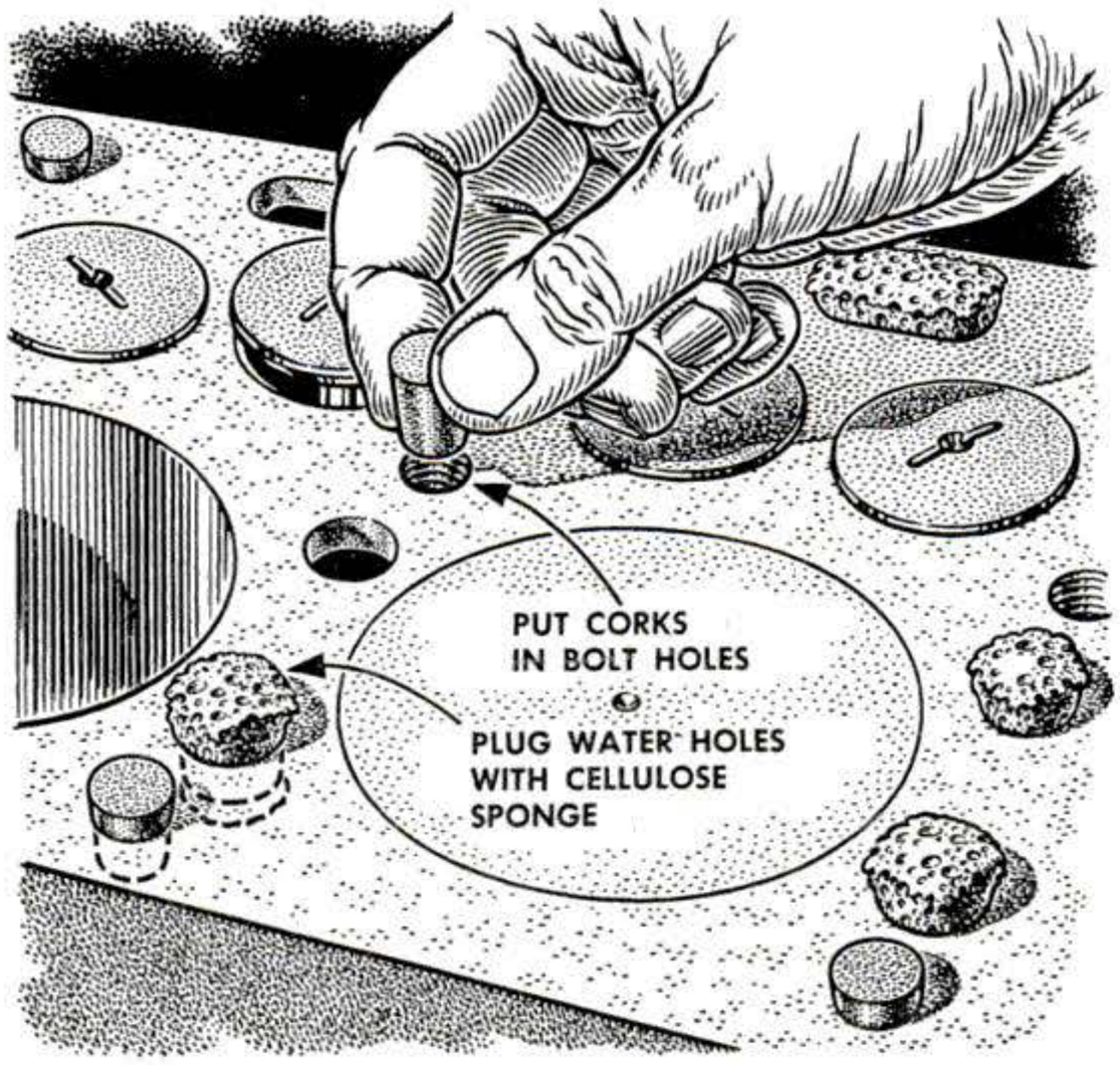
Hints from the Model Garage



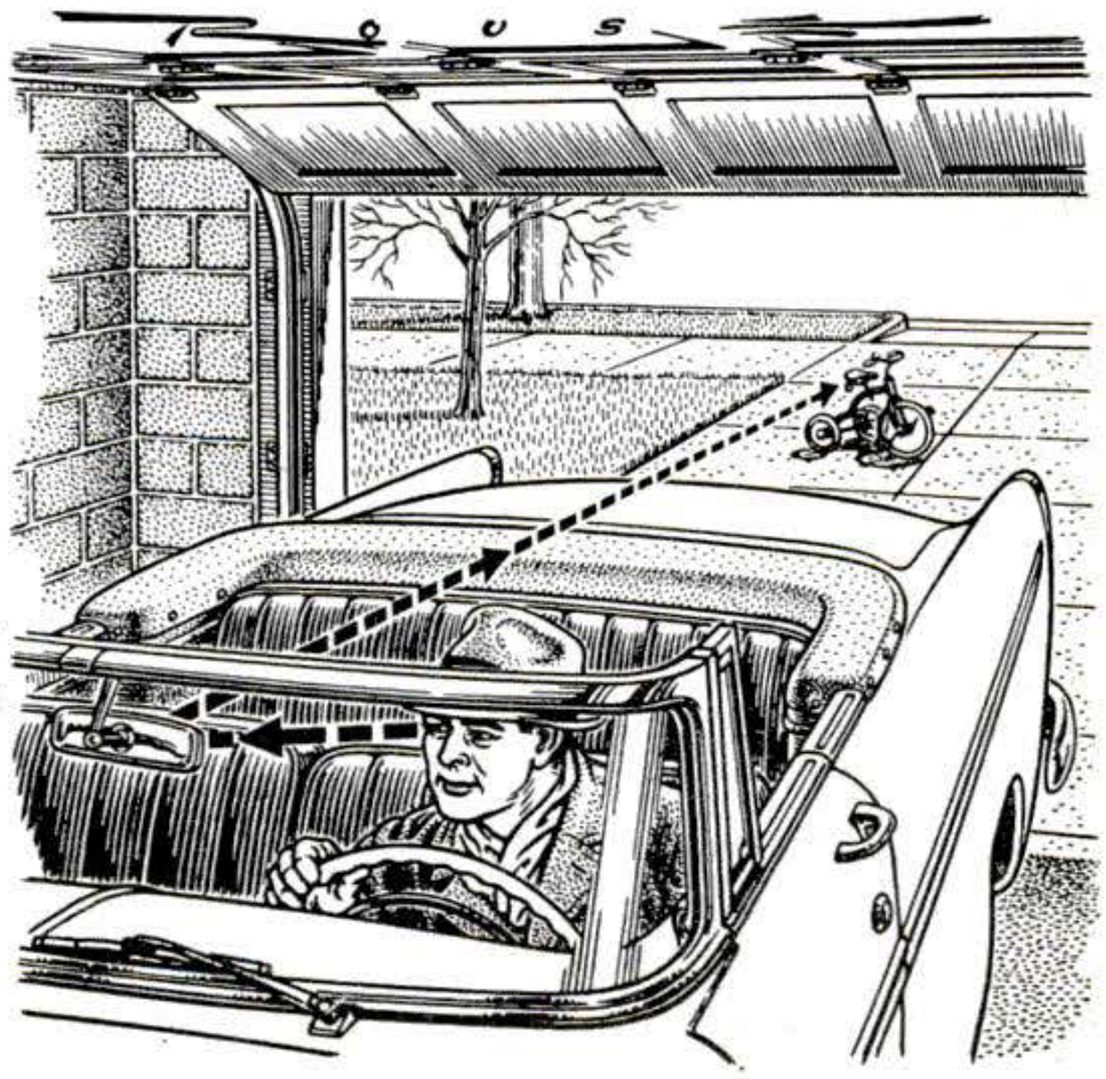
Creeping seat covers can be held in place by tucking a length of rubber hose between the seat cushion and the back rest. Smooth out the wrinkles as you force the hose down. Plastic hose won't work as well; it's too smooth.



Add a low fence to the shelf behind a car's rear seat to keep packages from sliding forward during quick stops. Cut the fence from ⅜" plywood and paint or upholster it to match the car's interior. Fasten it in place with small angles.



When working on an engine block with the cylinder head removed, plug the blind stud holes and water passages with corks or pieces of cellulose sponge to keep them free of carbon scrapings, valve-grinding compound and other loose dirt.



Take a good look through the rear-view mirror *before* you back down a driveway. If you start moving before you look, the rear deck may chop your rearward line of vision as you back out, so that it hides some object on the driveway.

Please turn the page for more auto hints

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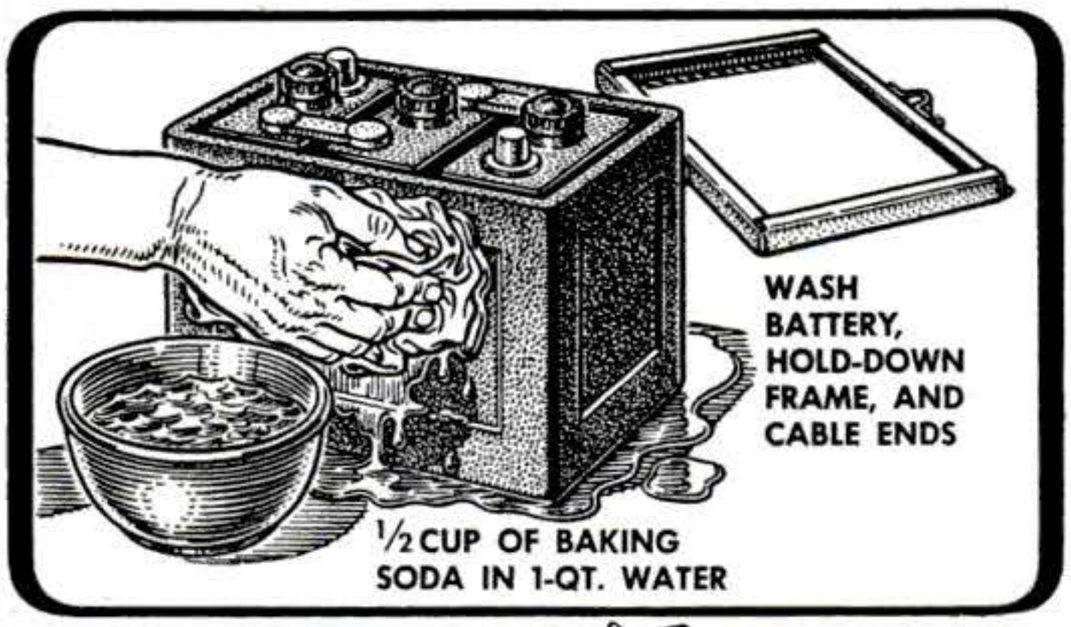
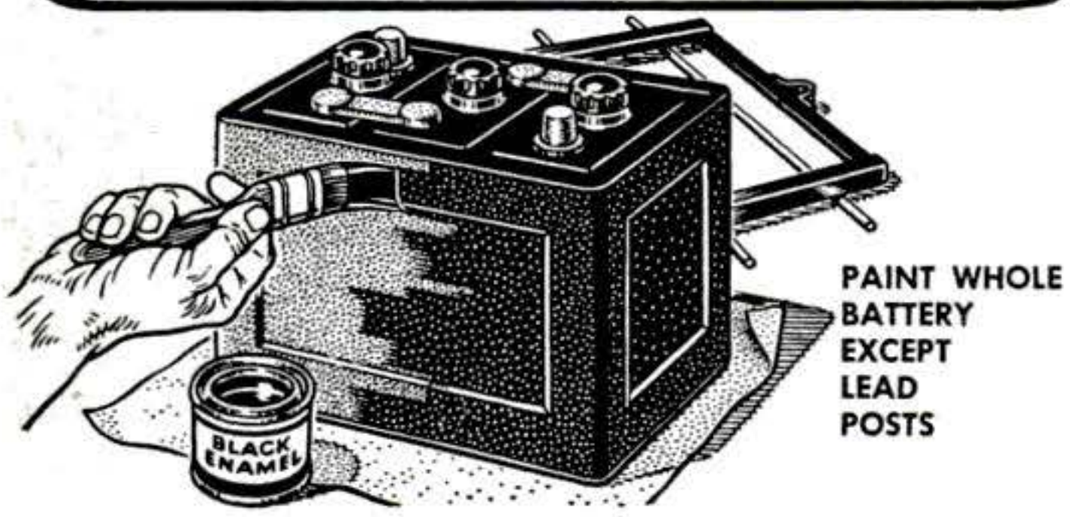
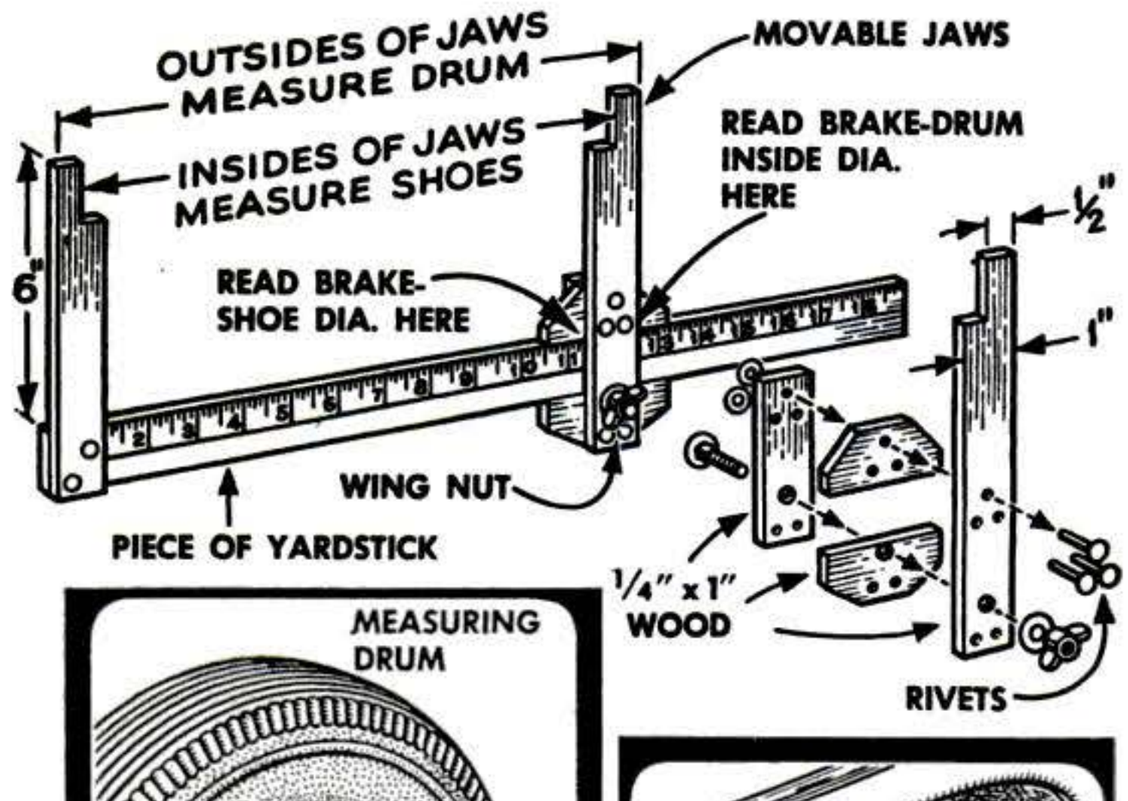
More Hints from the Model Garage

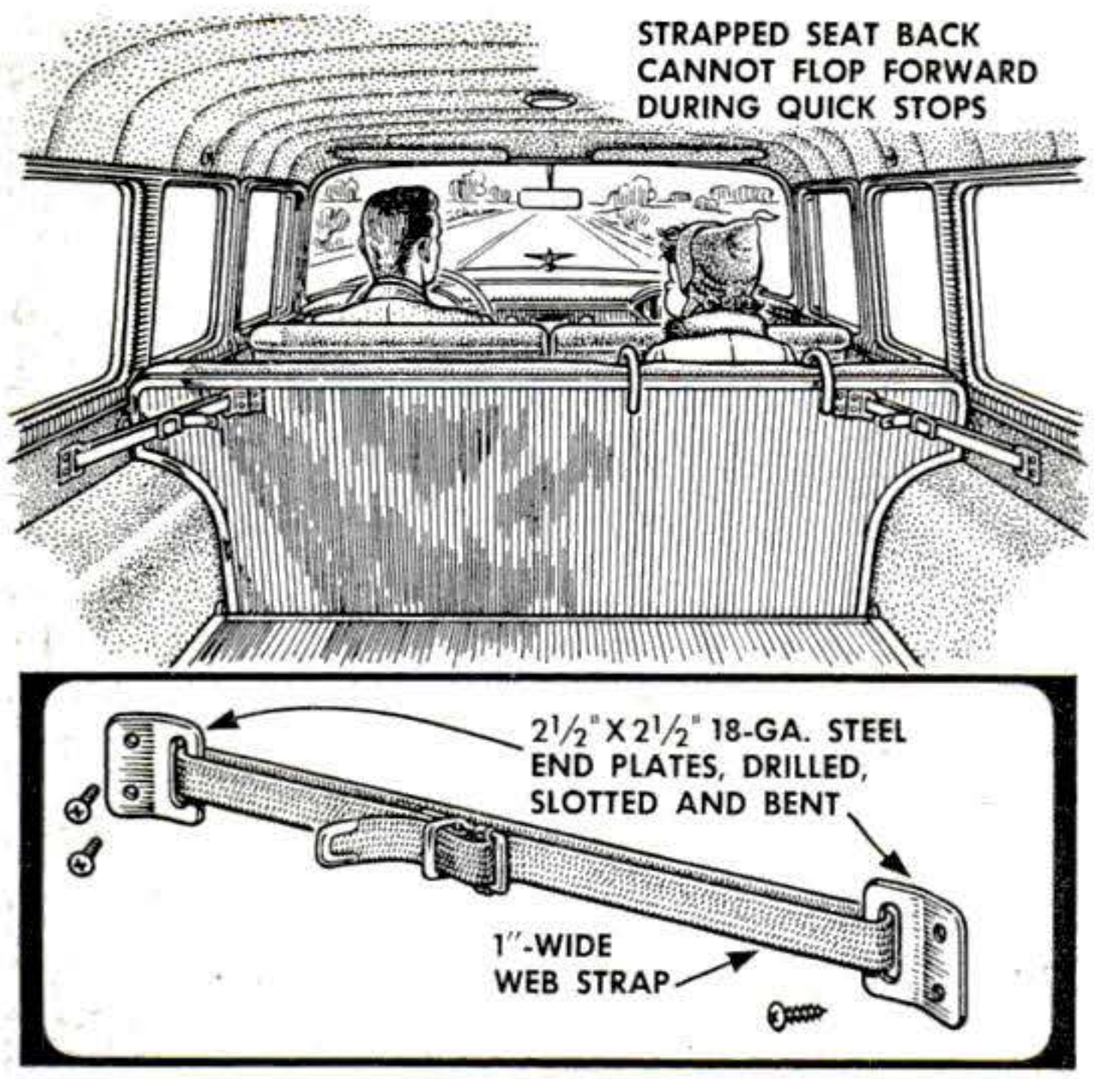




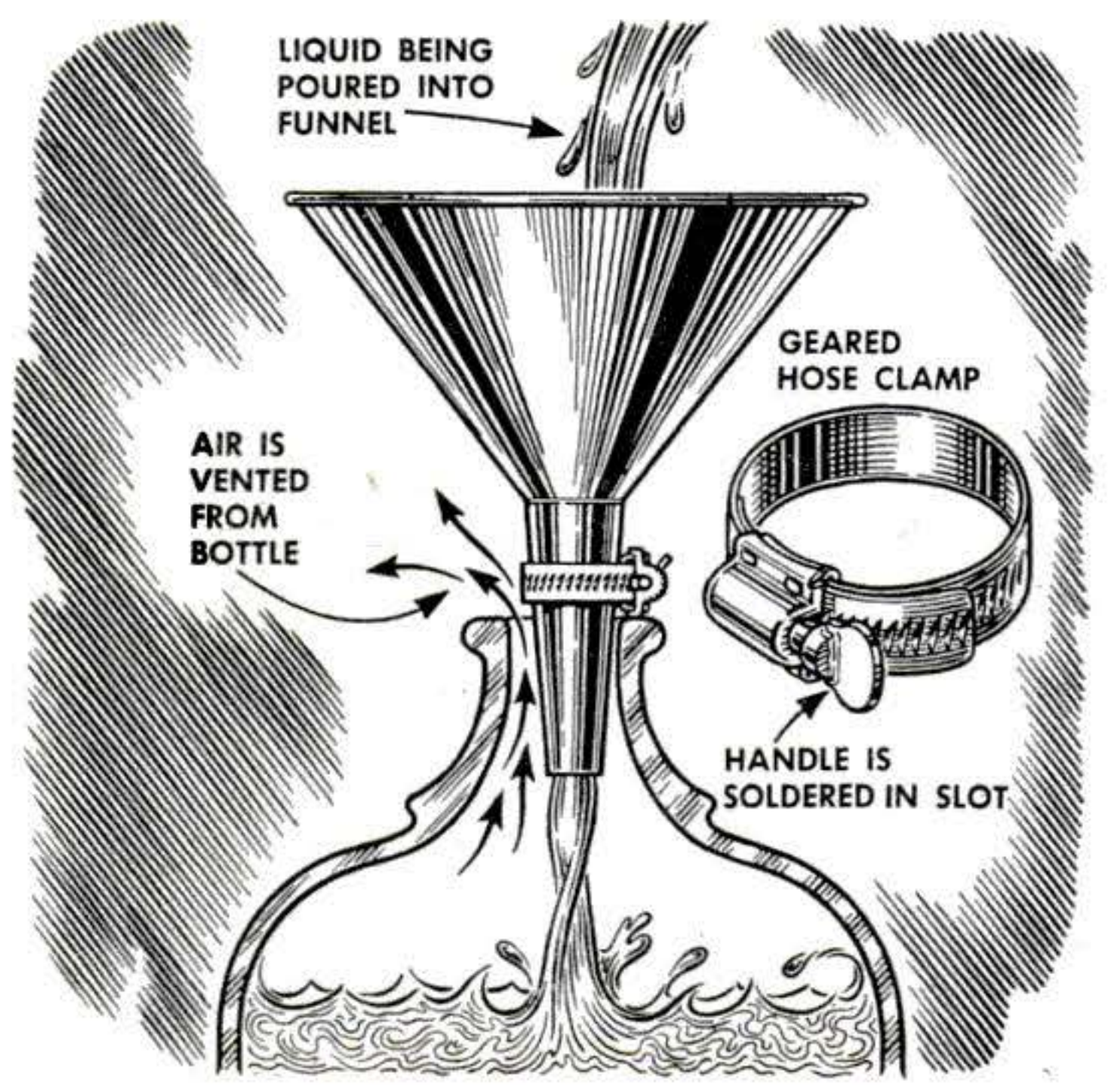
Stop tiny current leaks that steal power from your battery. Take it out of the car and wash off the current-conducting dirt with baking soda and water. When dry, paint the battery case, cell tops and hold-down bracket. Scrape the terminals and cable lugs clean for good contact and coat them with petroleum jelly.



Brake jobs can be speeded with a rough caliper built around a yardstick. By pre-adjusting the brake shoes to slightly less than the drum diameter, only a notch or two of adjustment is needed to complete the job after the drum is installed. Cut two jaws from ¼" wood or hardboard, fasten one and fit guides to the other.



A pair of web straps will keep the weight of a baby's car seat from tipping a station-wagon seat forward if you have to stop suddenly. Screw slotted brackets to the side of the wagon and the back of the seat; loop the straps through them.



When pouring liquids through a funnel, air will vent easier if a hose clamp is locked around the funnel's neck to hold it part way out of the mouth of the container. Move the clamp up or down to provide a ⅛" space for venting.

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Home and Shop

You can borrow good ideas today from

Tomorrow's Test Home

By Darrell Huff

HERE, photographed for the first time especially for POPULAR SCIENCE, is the X-100. It forecasts your next house in the same way that experimental "dream" cars hint at the model you'll be driving year-after-next.

Like the "X" cars, it's one-of-a-kind, cost a mint of money and is crammed with ideas. And like the cars, it's so dazzlingly special that you might not even enjoy it if you could have it. But the ideas you can get from it are something

"Stepping stones" of colored concrete are combined with cork tile to make this carpetless floor. The house has few walls, is supported entirely by steel posts and beams

It's hard to tell where indoors stops and outdoors begins. Patio is made of same concrete circles as floor inside. Full glass walls, driven by motors, slide out of way. Edge of metal roof bends down to help keep out sun

else again. They're far from farfetched.

Most of them could go into your next house. Quite a few can be added to your present home any time you want them. Some could be do-it-yourself projects today.

This dream house wasn't produced by dreamers. It was constructed by a big merchant builder, the Joseph L. Eichler organization. Eichler builds medium-priced houses that Northern Californians buy by the hundreds.

The X-100 was designed by Architects A. Quincy Jones and Frederick E. Emmons, from whose drawing boards have come many successful tract houses.

Eichler built the X-100 for the same reasons—aside from publicity—that have led car makers to turn out high-bracket dreamboats. He wanted to see if some radical ideas would work, and he wanted to find out if the public would like them.

The X-100 is primarily an experiment in space, light, materials and gadgets.

Space is handled by such a dramatic flow scheme that you move from room to room, covering more than two-thirds of the 2,310 square feet, without ever passing through a doorway.

The outdoors comes indoors in even more than the usual California manner. The back wall of the house is 56 feet of glass eight feet high, some sheets fixed, others sliding.

Much of the other walls is glass, too, or honeycomb plastic where privacy is needed. There are no conventional windows.

To balance the light from all the window walls, much of the central area of the square steel roof is pierced by plastic bubbles called Skydomes. One bubble, 32 feet long, runs through the core of the house from one interior garden to the other.

For equivalent light accents by night, the domes are spotlighted from above.

A steel roof of a type often found in commercial buildings is supported by steel columns and beams. It is topped by glass-fiber insulation and tar and gravel.

Since the steel skeleton bears all the weight, walls can be anything the designer's fancy dictates. In this house the

Revolving fireplace can be swiveled to face either of two living areas. A standard prefab model, it has its own lightweight chimney, can be installed on any non-inflammable floor or hearth

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opaque walls are heavy plastic-covered fir plywood permanently finished in a dark olive-green tone.

Most outside walls, however, are translucent honeycomb plastic or clear glass. The daylight they bring in is spread through the house by reflection from the ribbed-steel ceiling, which is finished in very light gray.

The floors are as eye-catching as anything in the X-100. Basically they are foot-square natural-cork tiles varied by plastic flooring in the utility room and unglazed gray ceramic tile in the bathrooms.

The expanse of cork is broken up in the two garden areas by tan and gray circles of exposed-aggregate concrete. Made by washing the cement from the surface, they have the appearance of fine, dense gravel.

Planters have been provided in the simplest possible way —by omitting the floor in half a dozen free-shaped areas in the garden rooms. Topsoil, sometimes mulched with gravel, fills the holes.

One material used here perhaps more generously than ever before in a house is the kitchen-counter type of plastic laminate. All doors, sliding as well as hinged, are covered by this impervious plastic, as are tables and countertops.

Sliding doors made of a new form of Formica plastic not yet on the market dress up cupboards in the kitchen and utility room. The quarter-inch-thick doors have a different-colored plastic face on each side, making them one of the most appealing gadgets in the glittering house. Since you can reverse the doors in their tracks, you can change the color scheme any time you want.

The eight-passenger dining table opposite the kitchen counter is also topped and edged with plastic laminate. Half

Wall-less dining area is typical of X-100's free-flowing *plan. Space can be closed off with curtains or thrown open to give access without doorways*

Plastic dome lets in sunlight

Ribbed-steel roof is left exposed to serve as ceiling on underside

Curtain slides in hidden ceiling track to make movable "partition"

Intercom doubles as radio speaker

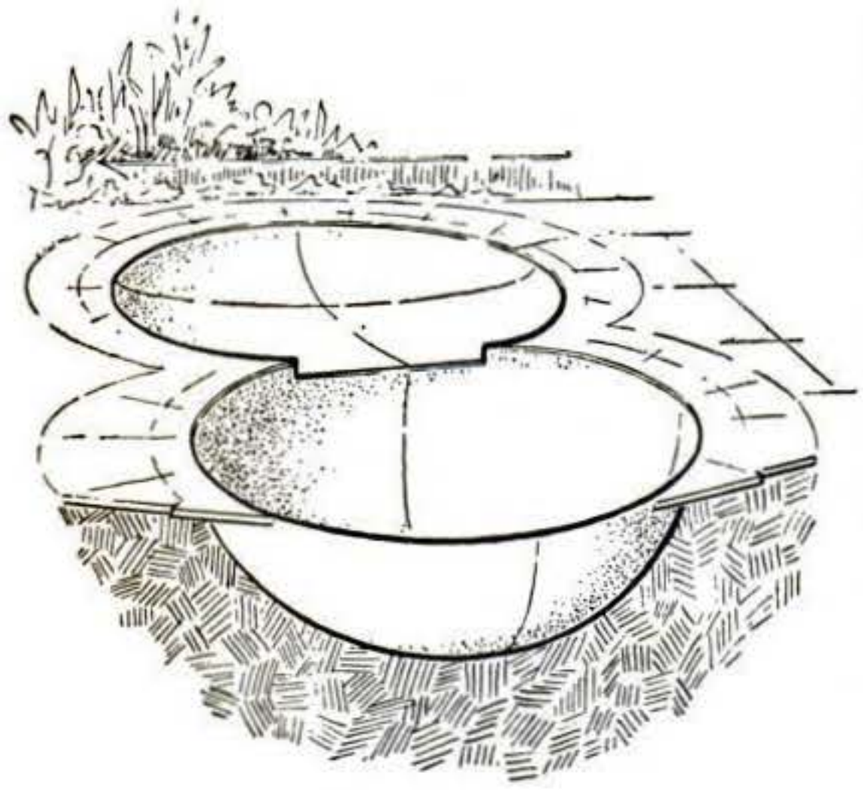
Indirect wall lamp of metal mesh

Dimmer switches adjust room lights to any desired brightness

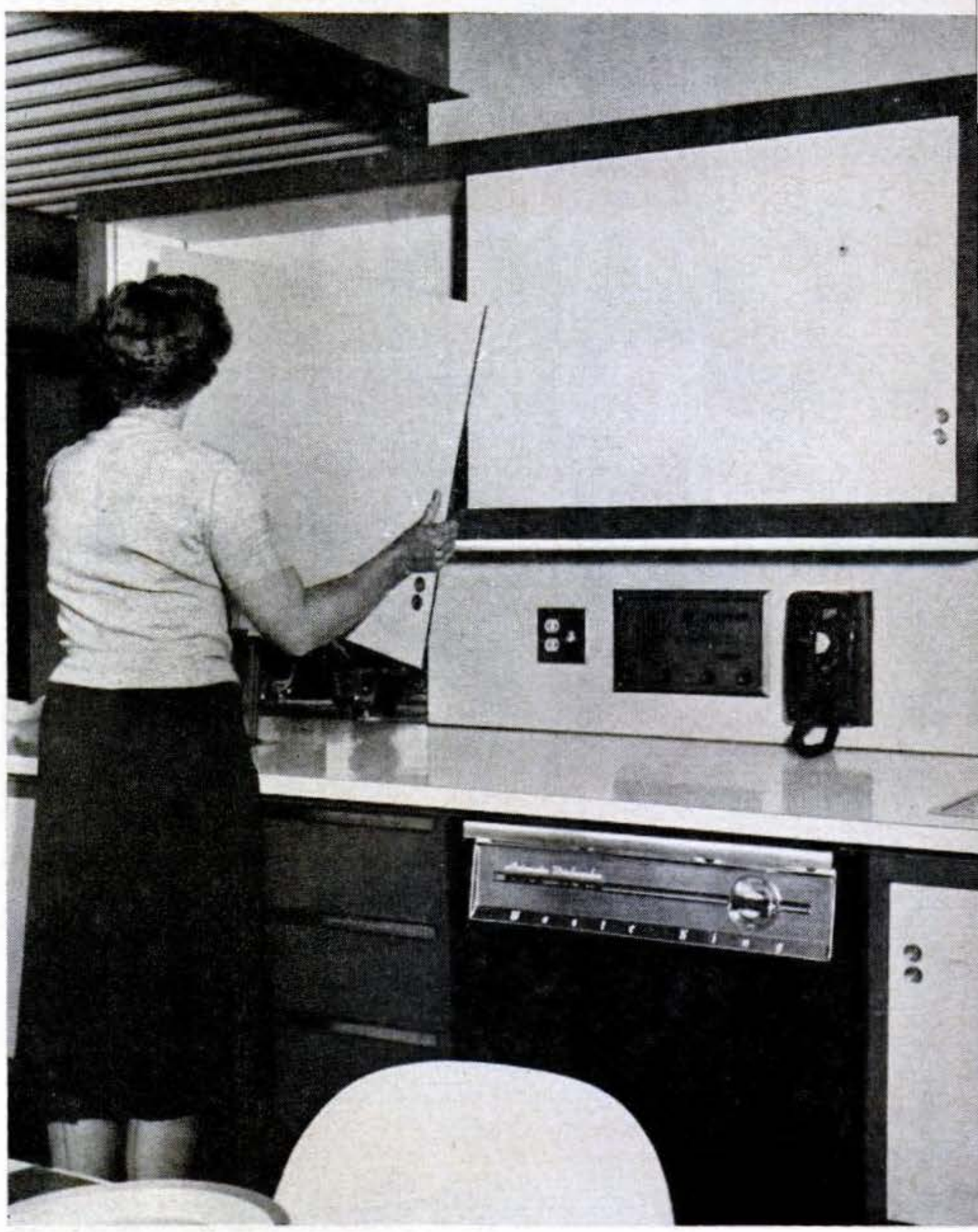
Permanently finished wall of plywood never needs painting

Plants grow out of "holes" filled with gravel in concrete-slab floor

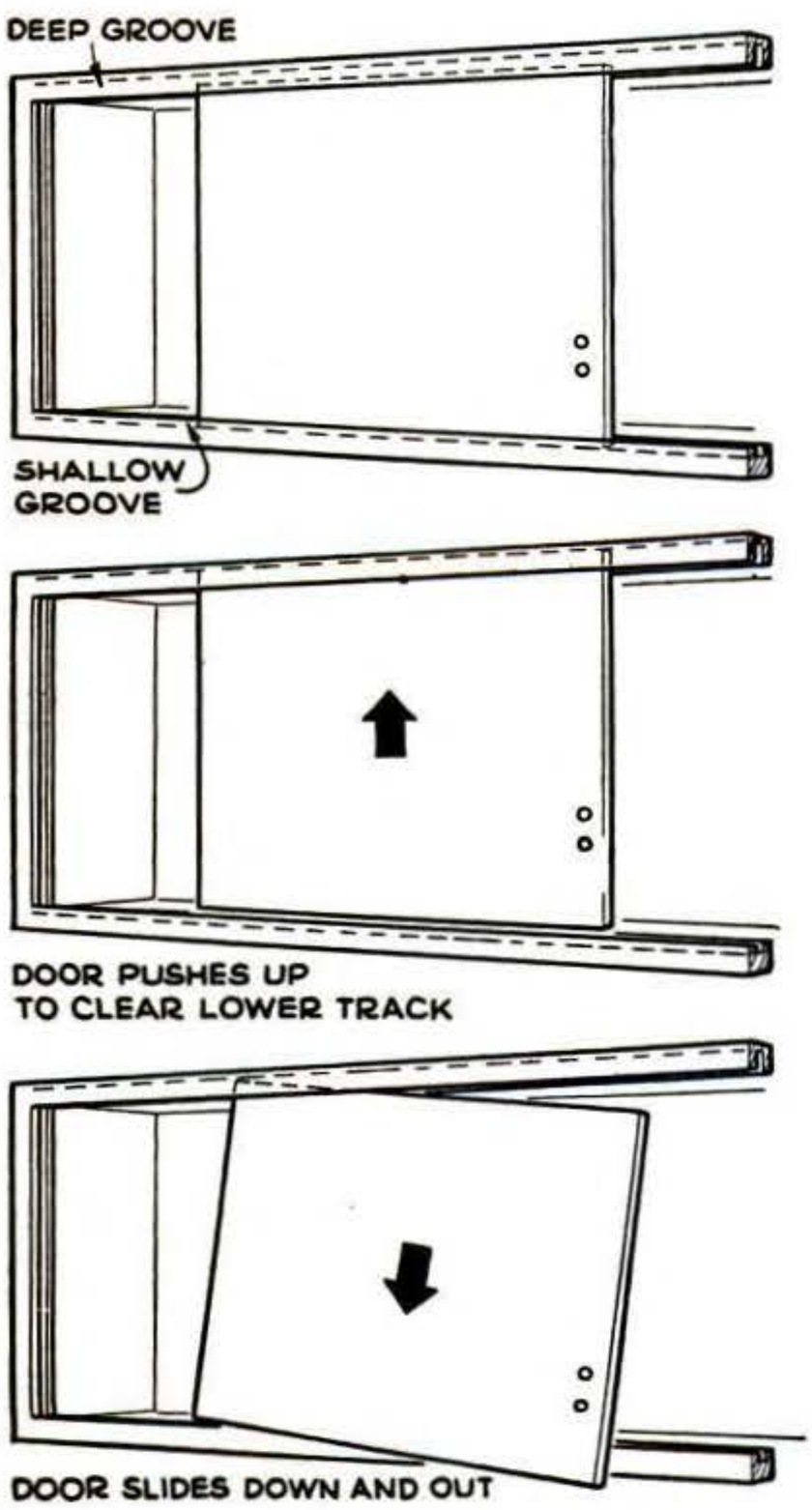
Gimmicks and ideas from house of



New double-circle pool combines a shallow section for kids with a deeper one for adults to give a big-looking pool



Kitchen color scheme is quickly changed by reversing double-faced cupboard doors. Single long counter groups sink, range, dishwasher, intercom and telephone



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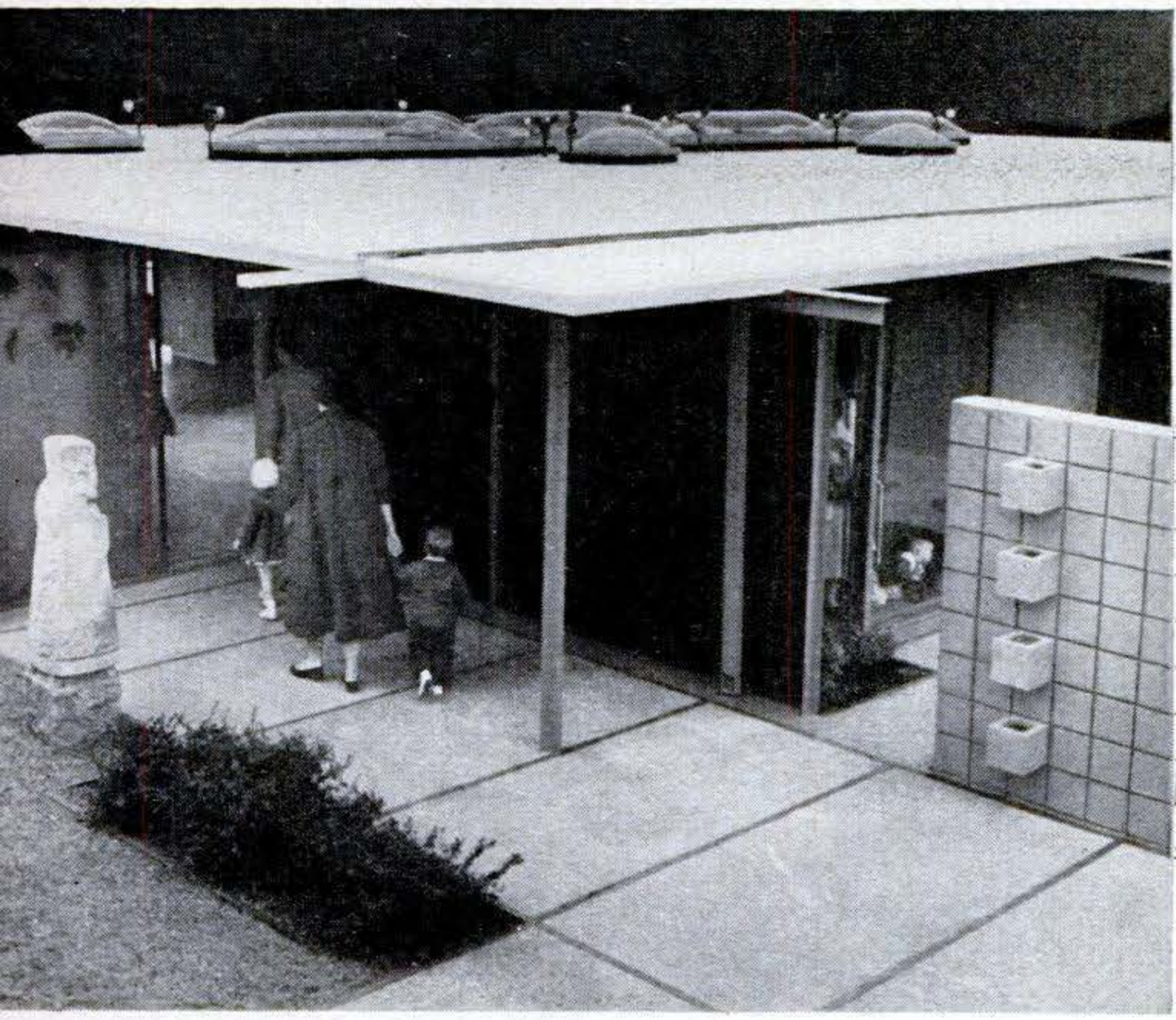
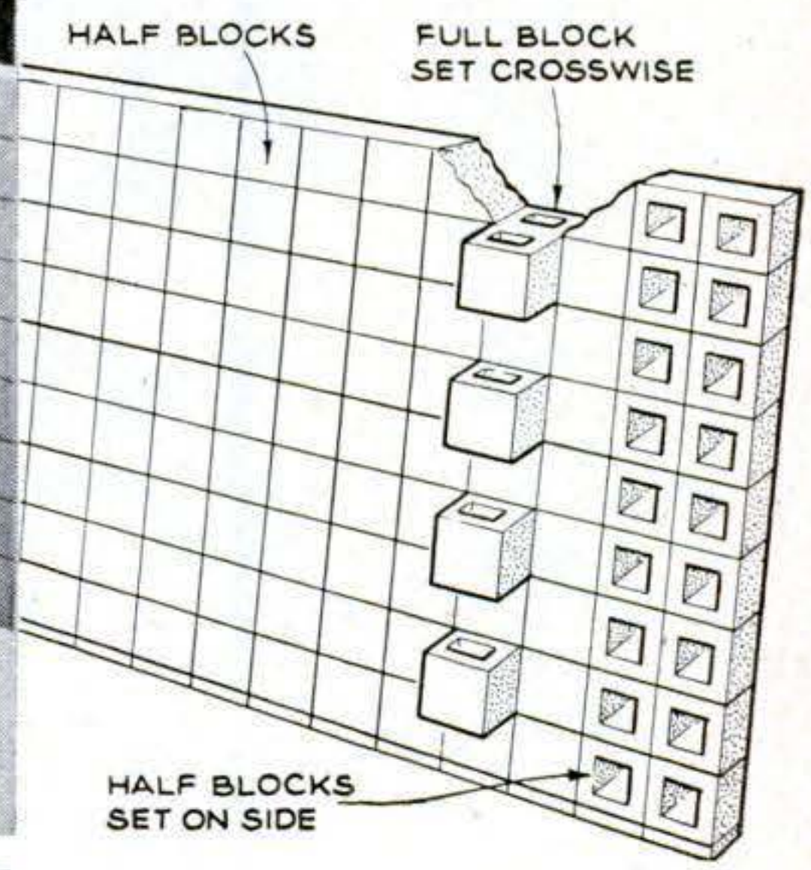
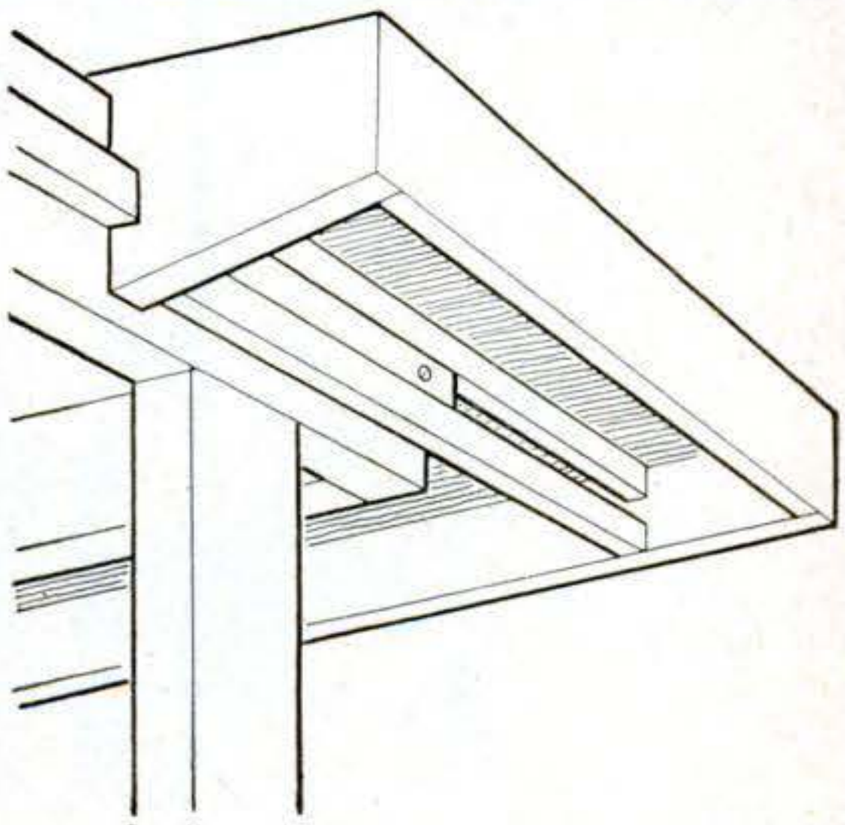
tomorrow that you can use today



Flat roof has plastic domes and floodlights for day and night lighting. Decorative walls are made of ordinary concrete blocks



You can cook right at this dining table. The end slides out on rails to expose a two-burner range built into a center well



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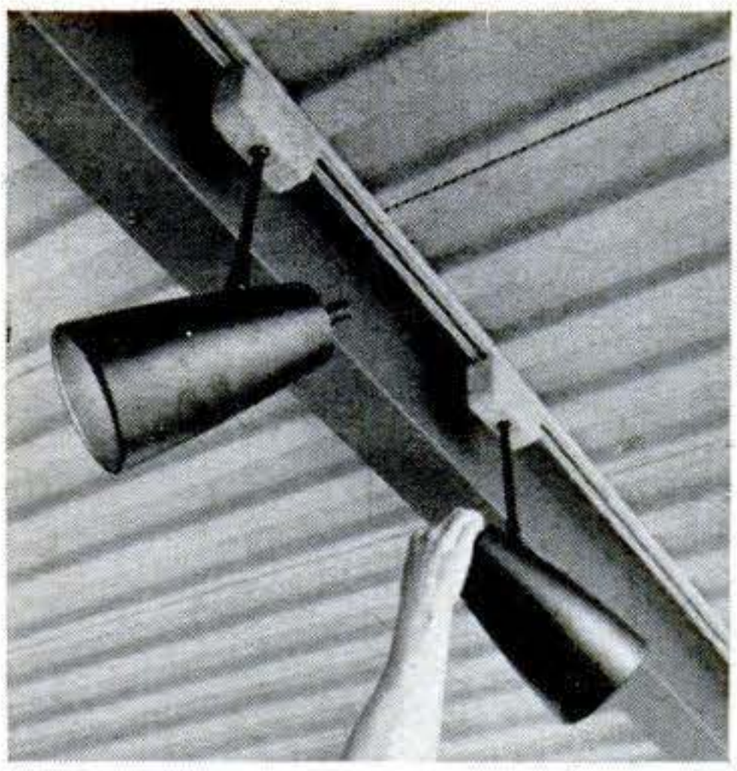


Sliding "bullet" light fixtures can be moved anywhere along electrical tracks that span the entire house. Tracks are a commercially available type that can be installed on any ceiling

of the table slides on rails to one side to expose a built-in electric cooking top for at-the-table meal preparation and to keep food warm for buffet serving.

All area lighting in the X-100 is controlled by dimmers as well as silent switches, making available any light intensity wanted.

Adding to the look of tomorrow in the Eichler X-100 are built-in appliances, some of which the public will be seeing for the first time. The jet-black automatic dishwasher is an ultra-quiet type (important in a house with few partitions) that will handle full dinner service and pans for eight.

The double oven is a one-piece unit that combines oven with rotisserie for smokeless broiling. The refrigerator unit at the end of the kitchen counter puts refrigerator above and freezer below for maximum convenience in use. The doors are stainless steel.

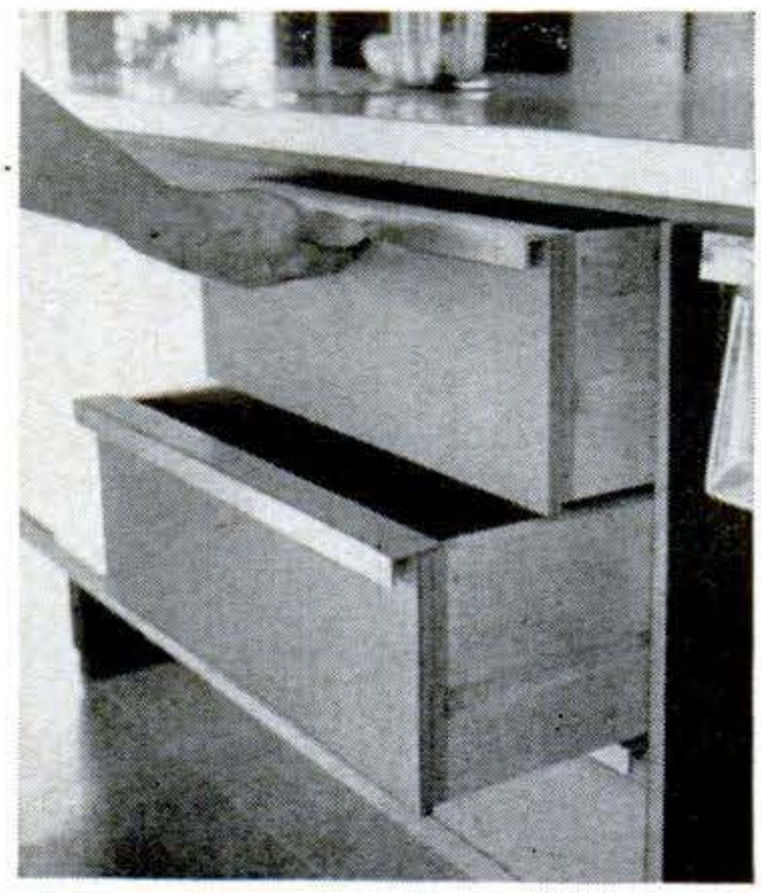
One wall of the master bedroom is all glass. It includes an electrically driven sliding door that can be controlled from the bed headboard.

Open planning has been carried very nearly to its limit in making the master bedroom fully open to the living and garden rooms. A curtain is the only closure provided—although Eichler has hastened to point out that a full partition could be used without affecting the structural methods.

The house stands on a sloping site, a 30-minute drive south of San Francisco. Very little of its construction would have seemed familiar to a conventional builder.

Work began with concrete piers topped by leveling plates. Cranes brought in 4″ steel columns to be bolted onto the plates. Eight-inch steel beams were then laid across to support the steel roof deck. The deck was spot-welded, topped by glass-fiber insulation and a built-up roof, then spray-painted on the underside.

Full-width drawer pulls in the kitchen are simple, handsome strips of brass angle. Edges are filed smooth and rounded, and strips are screwed to tops of the drawer fronts



The complicated slab floor was then poured—with its circles of brass to contain the areas of exposed aggregate—and the structural phase was completed.

A house of almost any plan and appearance could still have been built, even at this stage. Since the walls, both inside and out, bear no load, there is no restriction on them. Partitions can go anywhere. Walls can be translucent, opaque or clear glass.

All this hints at a house of tomorrow, mass-produced for economy—yet custom-designed to a family's own tastes and needs.

As with the dream cars that perhaps inspired it, you'll never buy one just like it. But it will be reflected in many ways in your home of the future. END

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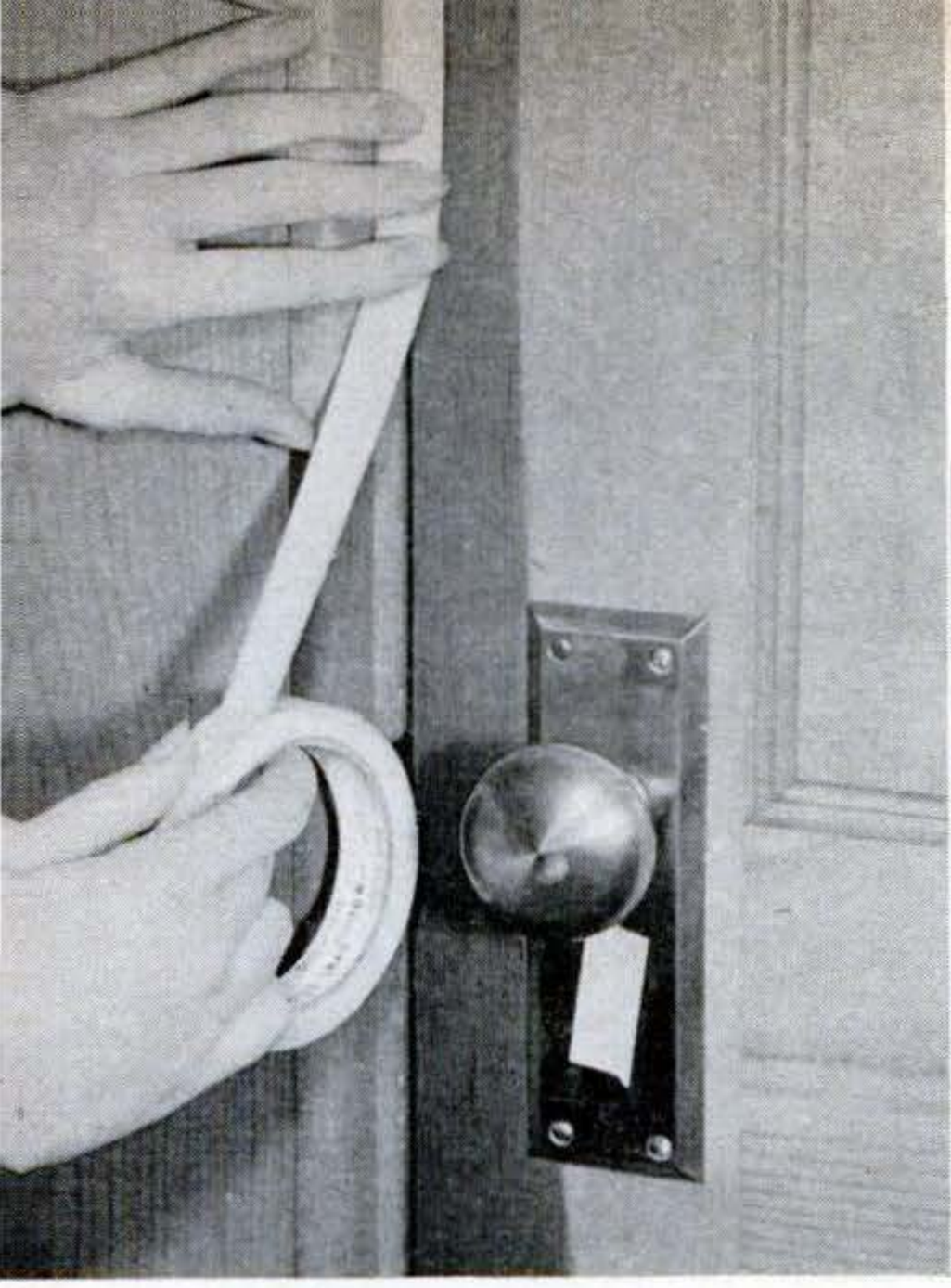
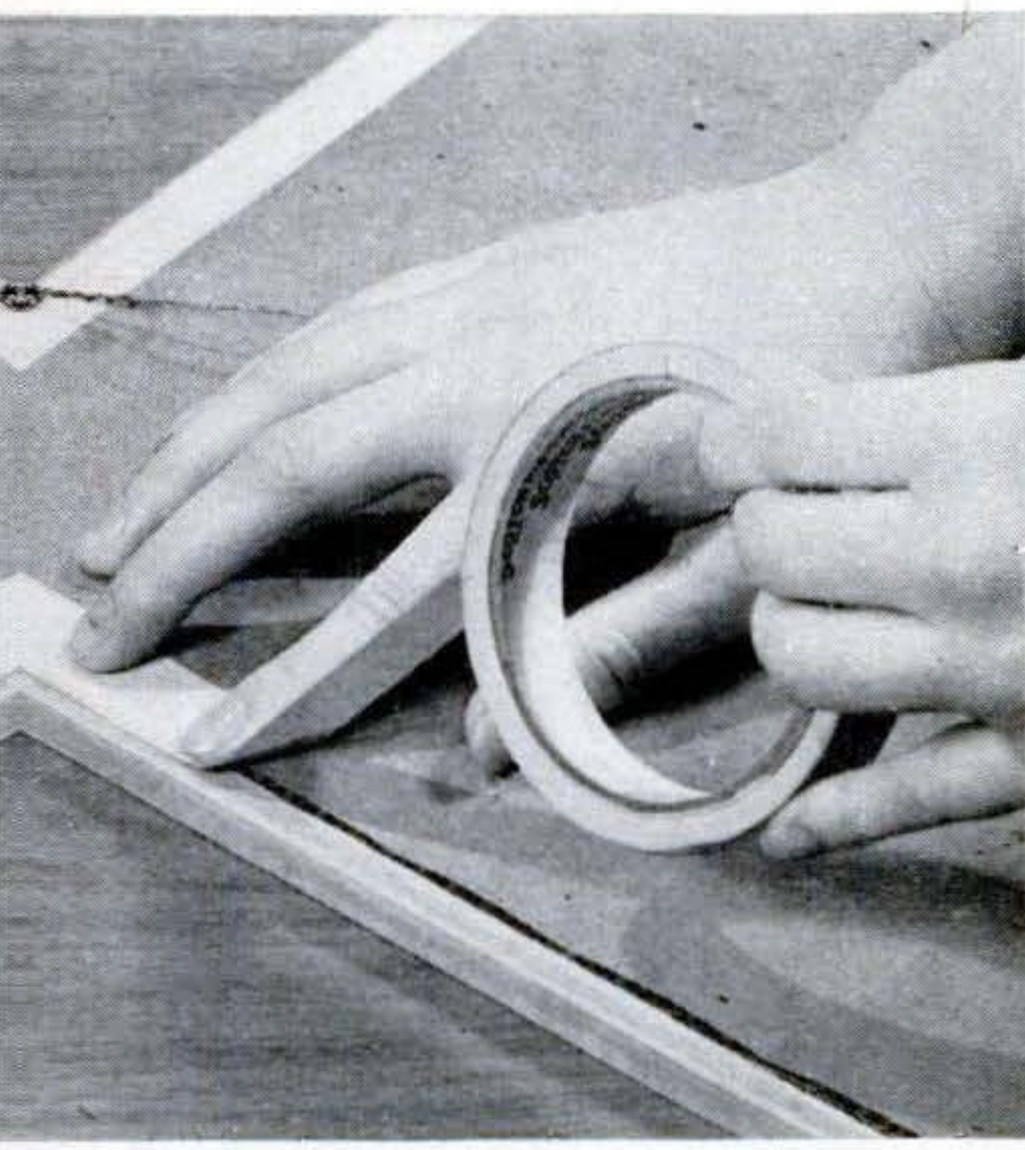
5 Handyman Uses for Masking Tape

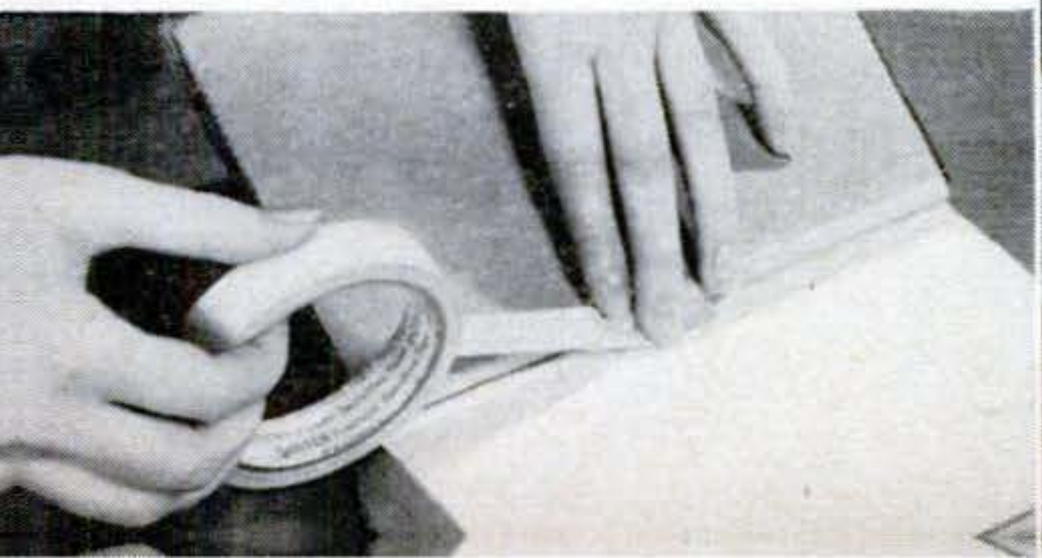


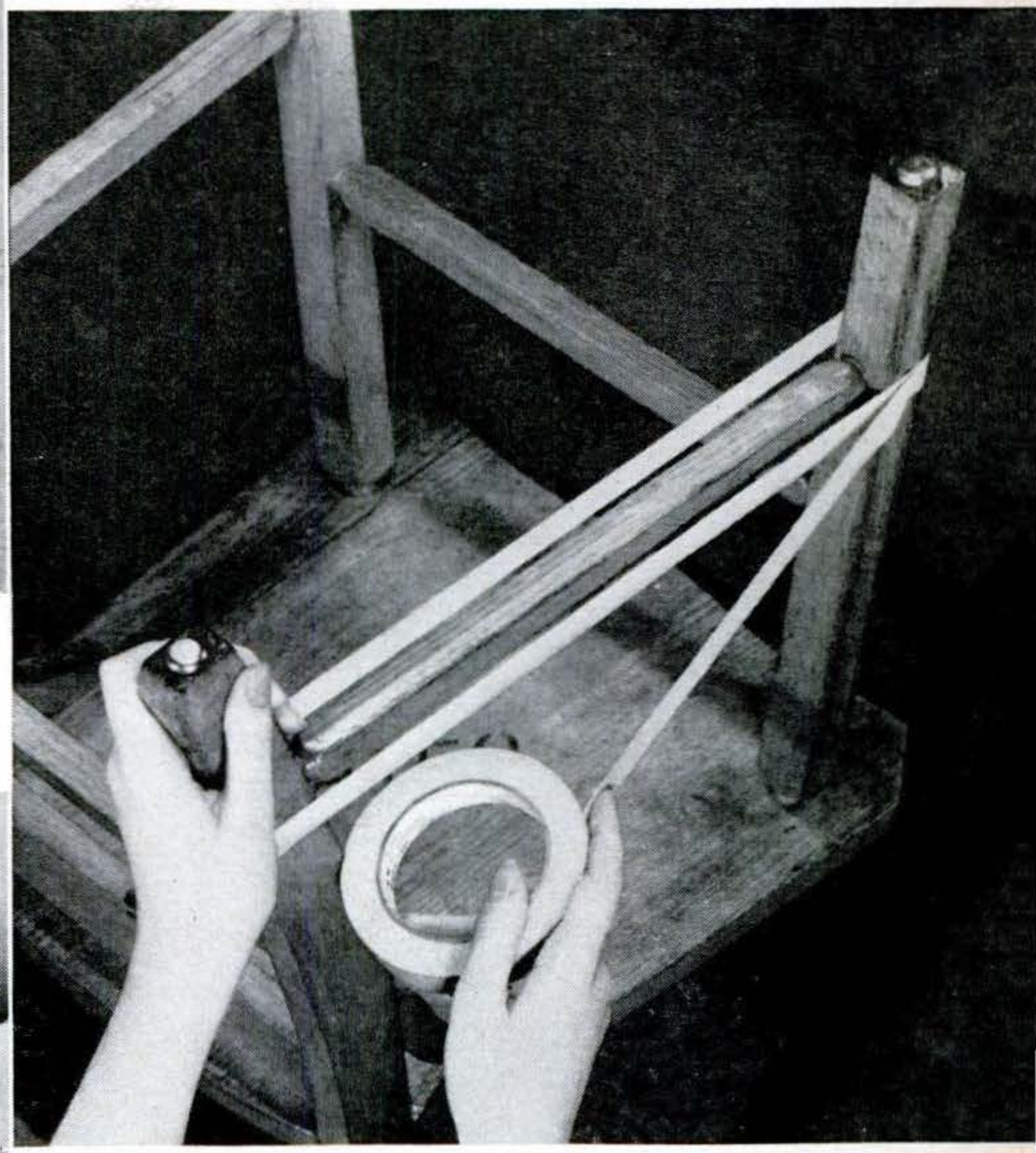
1 SEAL THE DOOR and the keyhole with masking tape when you mothproof a closet. It will lift off later without a trace.



2 WHEN FRAMING PICTURES, tape the backing to the frame. The dustproof seal goes on fast, peels off for changing prints.

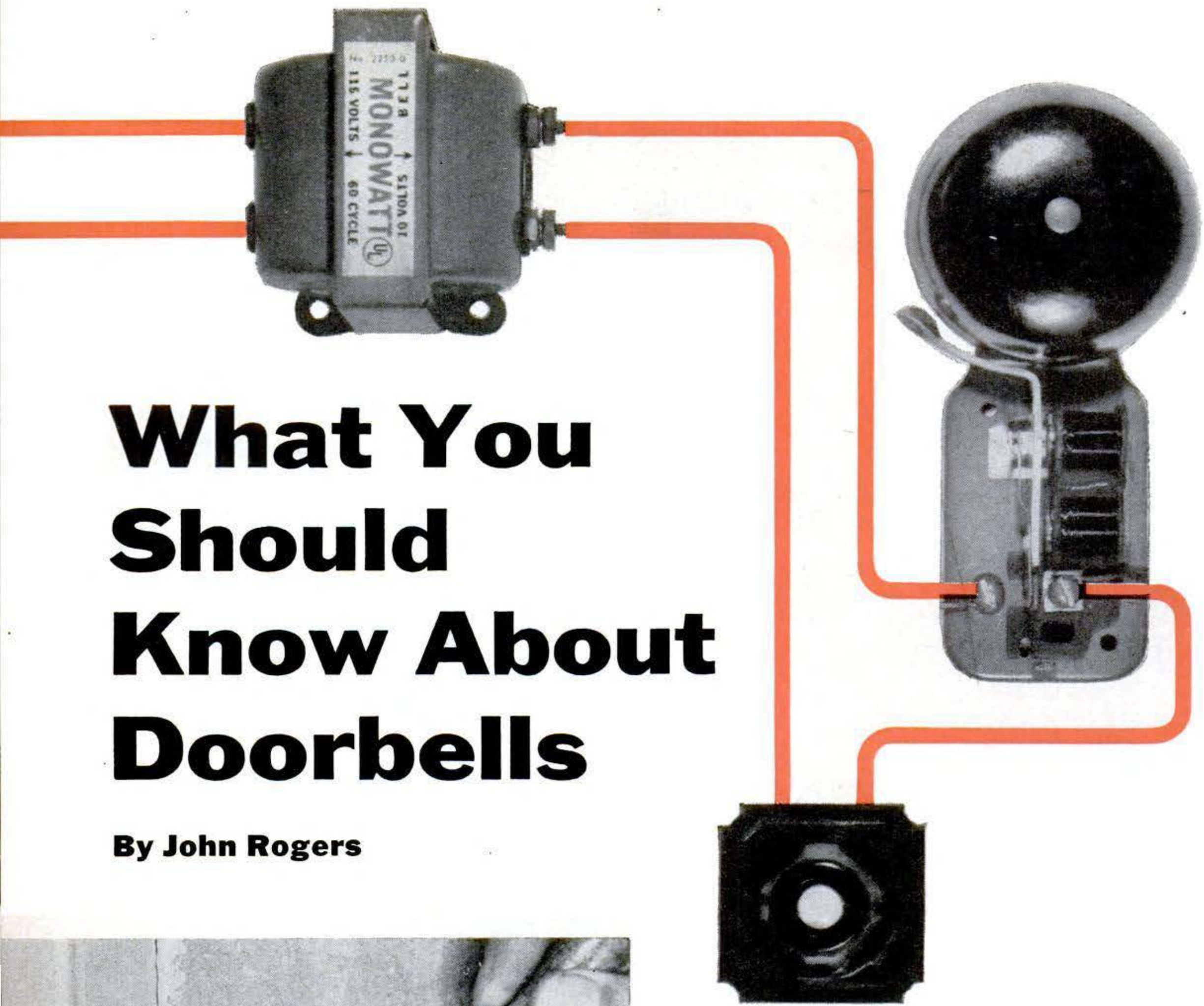
3 FLAPPING BOOK COVERS can be re-anchored with hinge cloths of tape run along the fold to grip the cover and end paper.





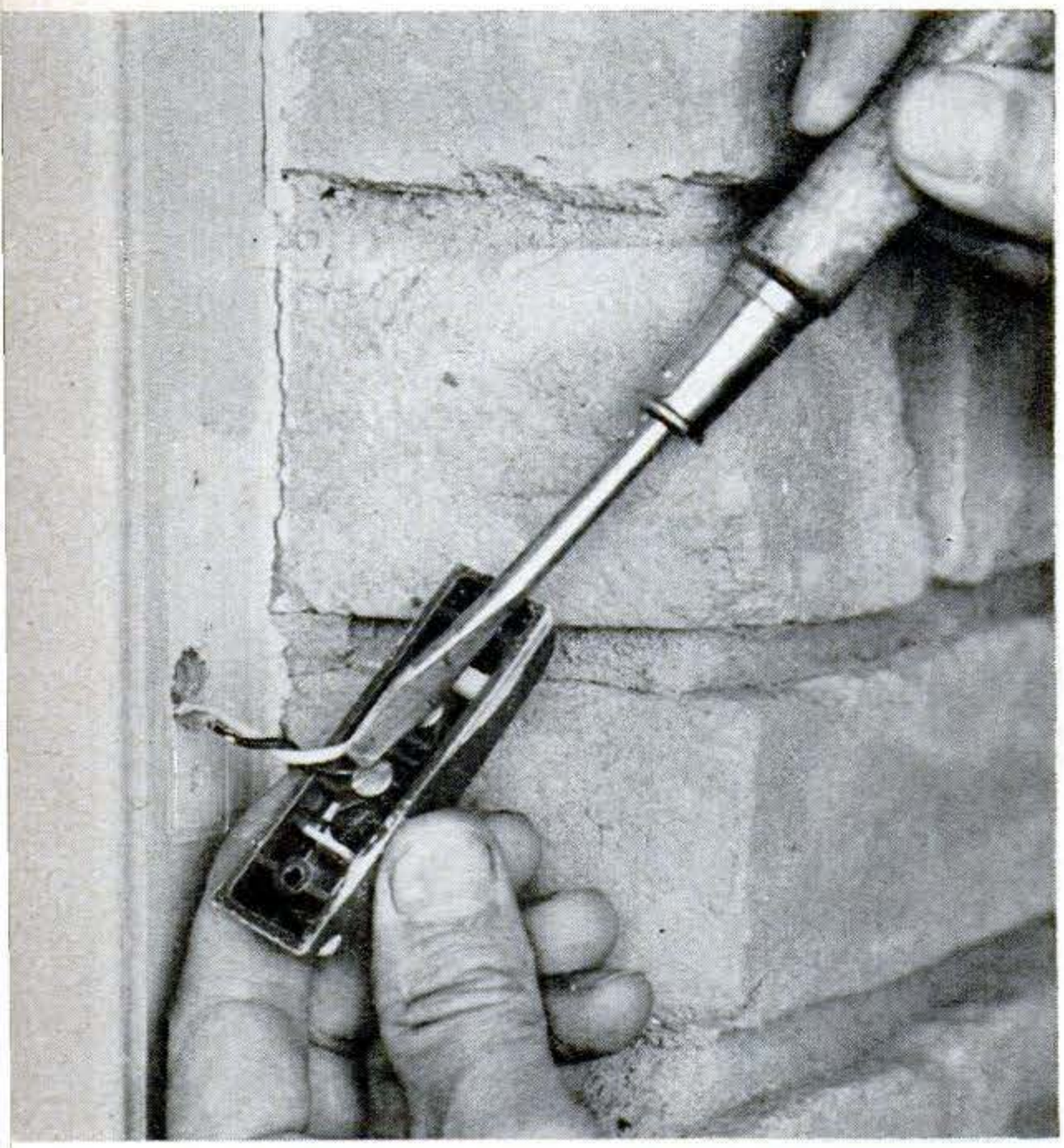
4 A TAUT WRAP OF TAPE will often hold work that is awkward or impossible to grip with clamps. Here a truss holds rungs in chair legs while the glue dries.

5 NO FURRY EDGES or spatters mar stripes and borders painted between strips of tape. As the work dries, move the strips along to paint the next stripe.



What You Should Know About Doorbells

By John Rogers



IF A BELL OR CHIME QUITS, first remove the button. See that wires are tight on terminals. Then bridge both screws with a screwdriver as shown. If signal sounds now, the button is bad.

A DEAD doorbell is a handicap no homeowner need live with. Anyone can find out why bells, buzzers or chimes don't work, and make them behave. The circuits are simple, and the voltage so low that they are safe to work on.

When a bell fails, first check the push button (photo at left) to make sure its wires are tight and not touching each other. If a wire is broken, strip the insulation back and reconnect it.

If the test shows that the button is faulty, its contacts are dirty, corroded or broken. Replacing it may be easier than repairs; a new button costs little.

If shorting the button terminals doesn't ring the bell, the power supply may have failed. It will be either a bell transformer (which takes power from

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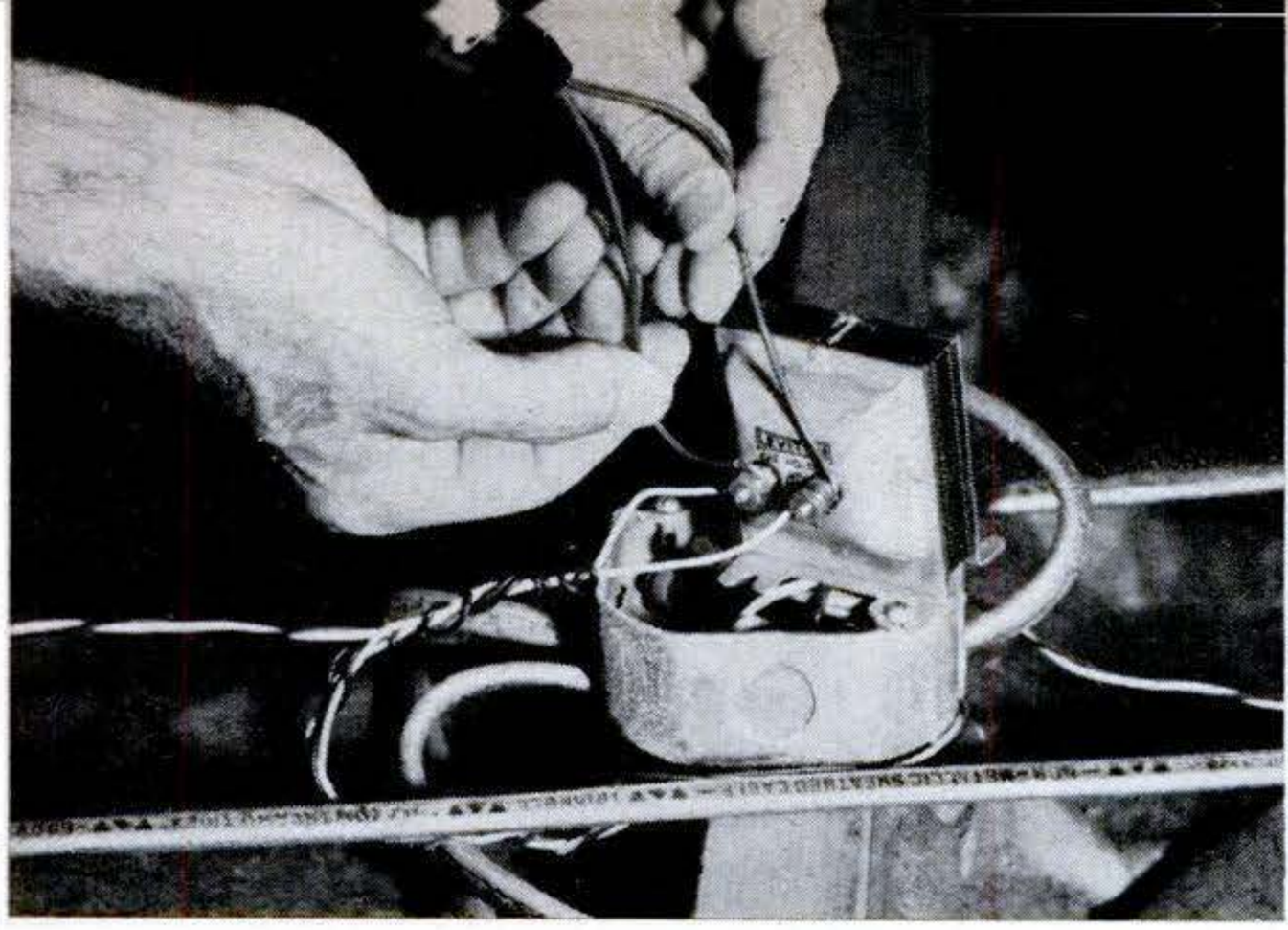
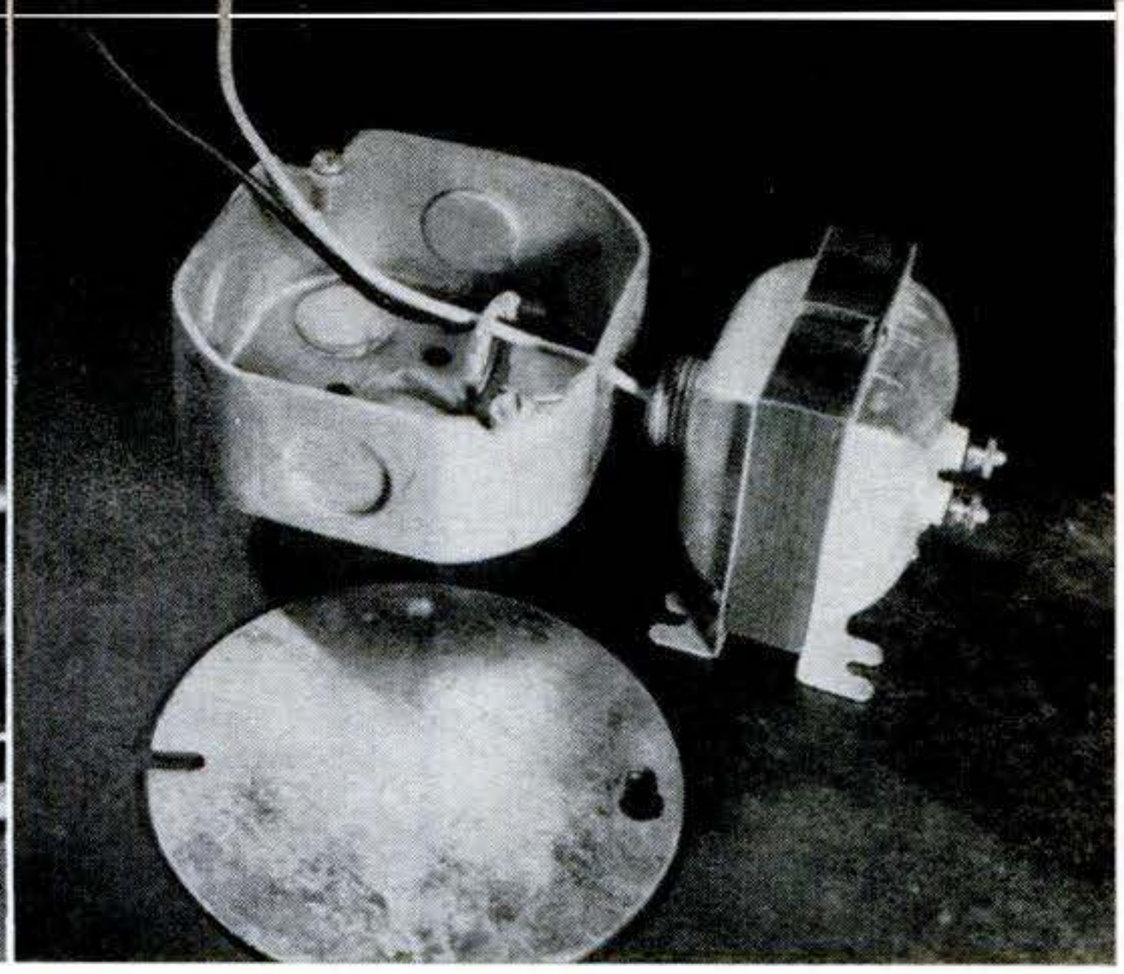
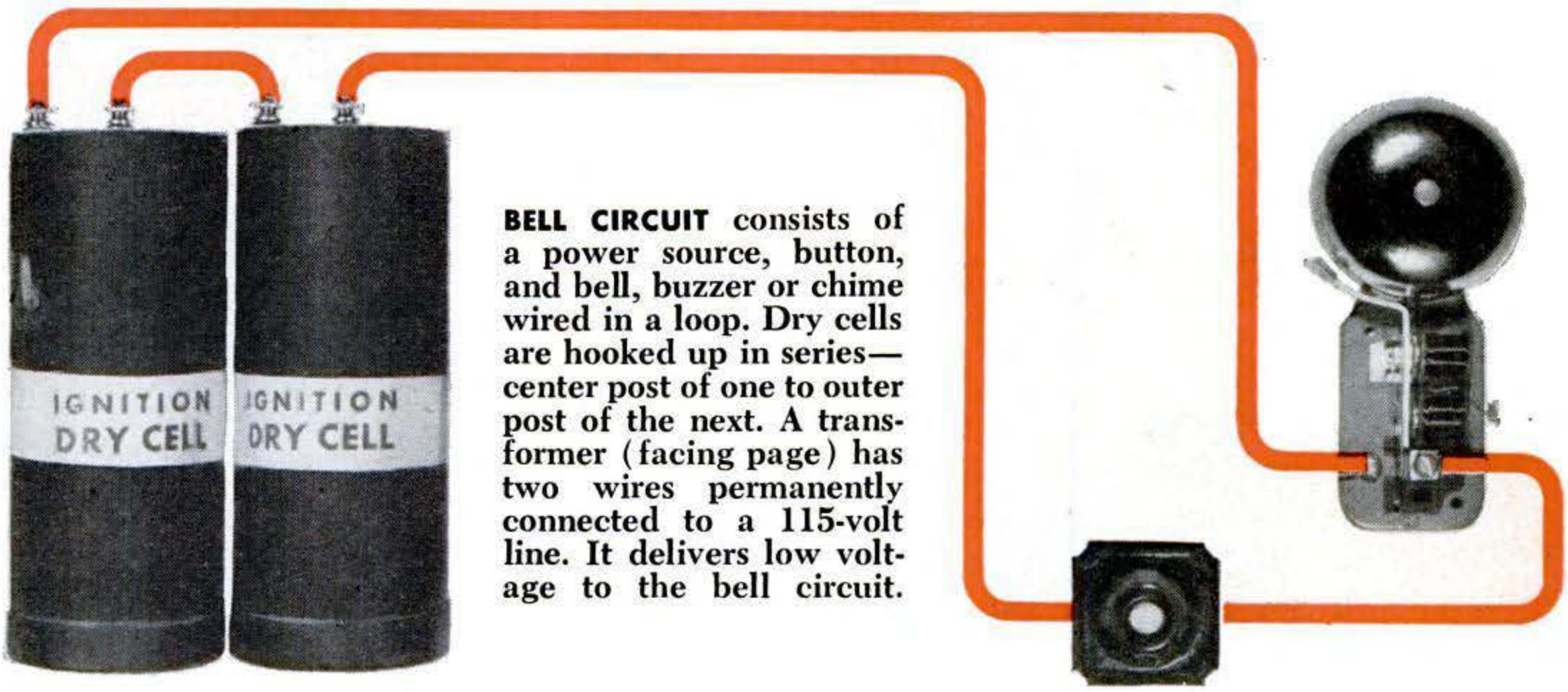


A TRANSFORMER CAN BE TESTED by touching its low-voltage terminals with two wires hooked to an auto-dashlight or six-volt flashlight bulb. If the bulb lights, the transformer is working.



BEST MOUNT for a bell transformer is a junction box or cover. You can fasten the type shown to a knockout hole in the box. If you're unsure of 115-volt connections, call an electrician.



BELL CIRCUIT consists of a power source, button, and bell, buzzer or chime wired in a loop. Dry cells are hooked up in series—center post of one to outer post of the next. A transformer (facing page) has two wires permanently connected to a 115-volt line. It delivers low voltage to the bell circuit.

the house line) or dry cells. A transformer is usually mounted on an exposed junction box in the cellar or attic. Dry cells may be in a closet or on a shelf.

How to check the transformer. A slight hum is normal, but if a transformer feels hot, there is a short circuit in the system. Before trying to locate it, disconnect a wire from one of the transformer's two low-voltage terminals.

Assuming the transformer is not hot, see next whether it is delivering juice. Disconnect a bell wire from it (if it sparks as you do, see below). Then bridge the two terminals with metal for an instant. It should spark now, if the transformer is working. You can also use a bulb as shown in the photo, at upper left. If such a test shows no sign of current, you need a new transformer. But if the transformer is operating, the bell or its wiring is at fault.

Test dry cells individually. Swollen or leaky cells are definitely bad. An ammeter, touched *briefly* to the two posts of a good cell, should flick over to 25 amperes at least. You can use a buzzer instead; it should sound vigorously when connected across a single good cell.

If even one cell is weak, it pays to replace all. Buy the big No. 6 cells rated at 1½ volts each. Hook them in series with short pieces of No. 18 wire, leaving one center and one outside terminal free.

Sparks are a clue. After you're sure the power supply is okay, brush that one wire you disconnected against the same terminal to see if it sparks.

• If there are sparks and the bell rings, the button circuit is shorted. Now

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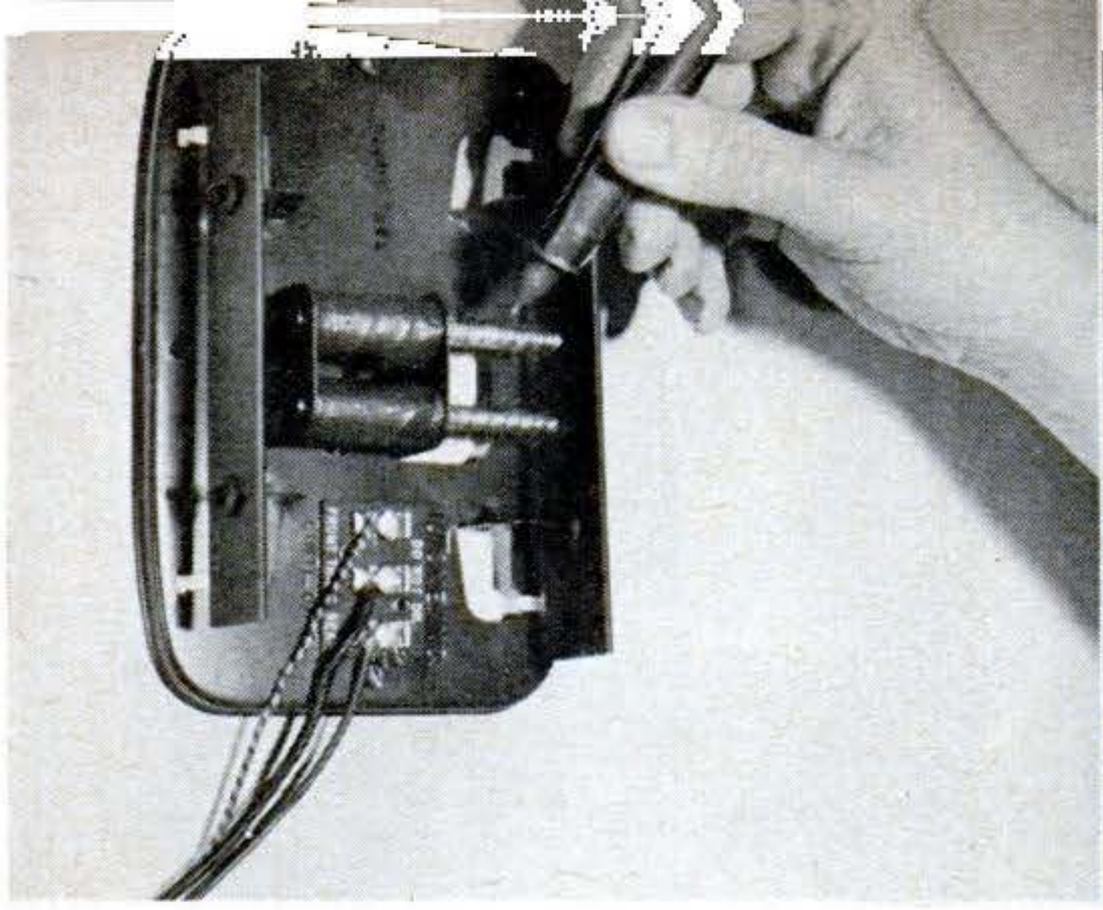
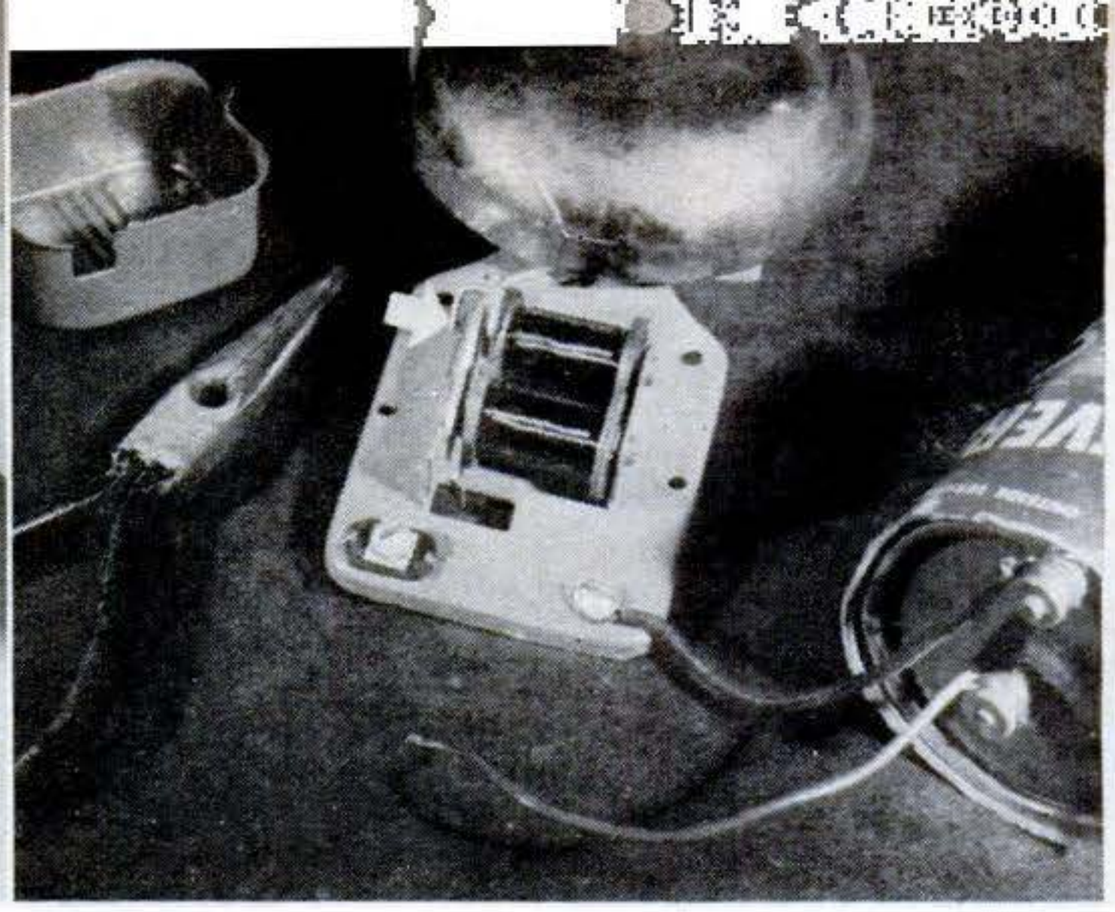


MOST LIKELY TROUBLE with chimes is a greasy deposit on the plungers. Clean them with a brush and solvent, taking care not to damage the springs. Lubricate plungers with talcum or powdered graphite. Never use oil. See that the wires are tight and not touching each other.



TO SERVICE A BELL, snap off the cover. Make sure wires are tight on terminals. Brush out dirt. Draw a piece of clean paper between the contacts (arrow). If bell still does not work, have someone hold the door button, and cautiously bend the stationary contact in or out.

disconnect one wire from the button; try the power-supply wire again.

• No ring or sparks now? The short was in the button. Put in a new one.

• Both ringing and sparks, with button disconnected? The short is between the wires to the button.

• Sparks but no ring? Either there is a short in the wires from the power source to the rest of the system; or else there is a short in the button (or its wires), and the bell is defective, too.

To find out which is the case, disconnect all wires from bell, buzzer or chime terminals (better identify them with tape). Keep the bared ends well separated. Then try the power-source wire again for sparks. If you still get them, the short is in the wires.

Inspect the wires. Look for chafed insulation where they pass through holes or over edges, or lie across pipes or BX cables. Separate paired wires. If you find chafed spots, tape them up.

If the trouble still can't be found, string new No. 18 plastic-insulated bell wire. Don't damage insulation as you pull it through holes or across corners. Lay wire inside molding and baseboard grooves. Carry long runs through the cellar or attic rather than rooms, bringing the wire out through small holes. Insulated staples come in colors to match walls and woodwork.

Check the bell or buzzer if everything else seems all right. One way is to disconnect the wires from it, hook them to a new one, and press the button. Another is to disconnect the bell and touch the two wires from a good dry cell to it. Bells and buzzers are cheap and hardly worth trying to repair.

Trouble with chimes? Since chimes have no contacts, a short circuit in the push button or its wiring will not cause them to clang but only to hum, the plunger being held in the solenoid. Disconnect one wire until you can eliminate the short.

New chimes are as easy to install as a new buzzer, but unless you plan to replace your transformer, be sure to buy a chime that will work on a 10-volt source.

A new transformer. Current is cheaper from the line than from dry cells. However, installing a transformer in place of a battery, or replacing one that is burned out, involves working on a 115-volt circuit.

To cut off all house current, pull the main switch. Then open the junction box, draw out the wires to which the old transformer is connected and detach it. Connect the pigtail leads of the new one to the same points. Solderless connectors make this easy. If you solder the joints, tape them well. Connect one bell wire firmly and check with the other for sparks that may indicate a short in the system before hooking it up. END

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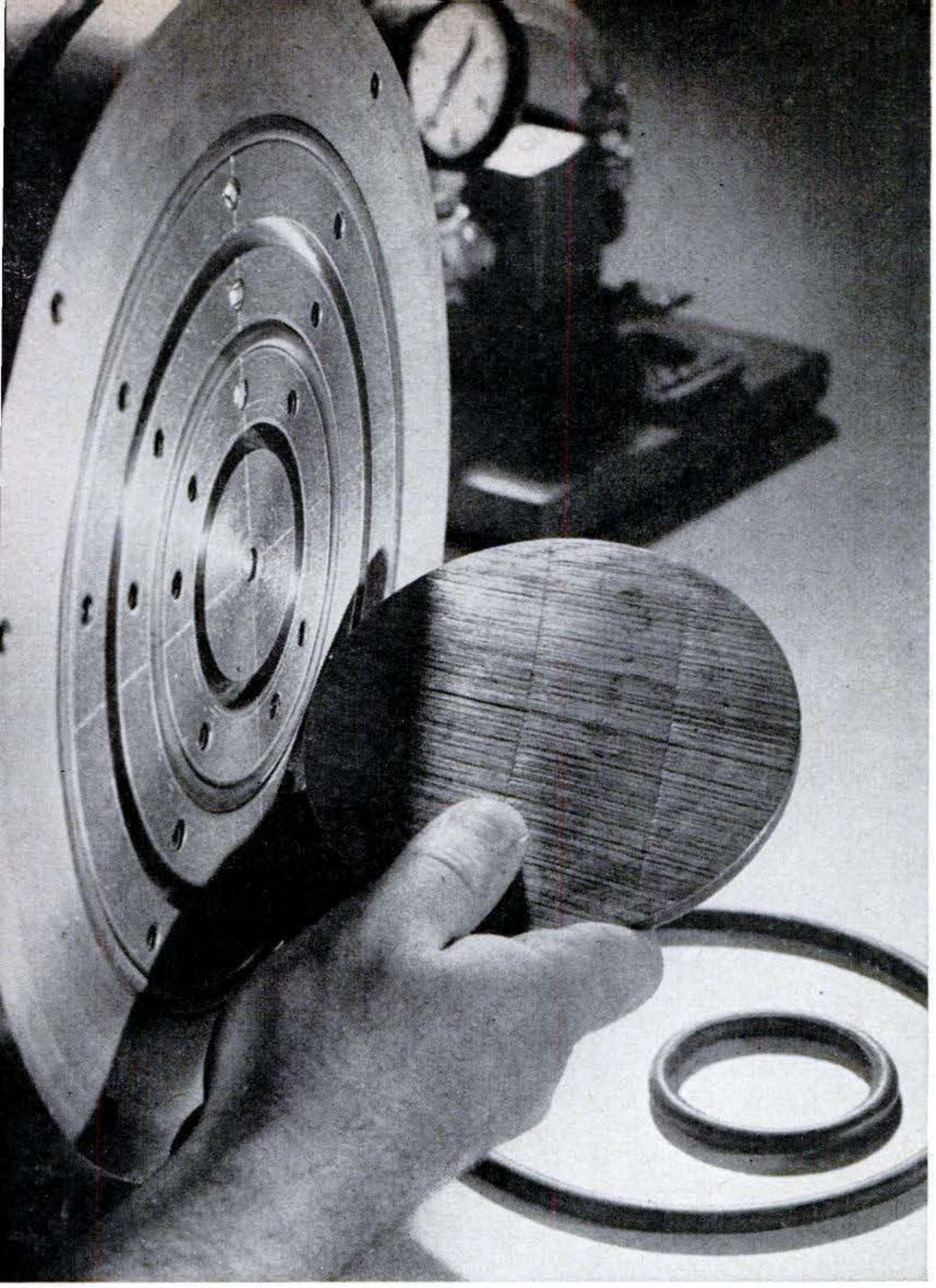
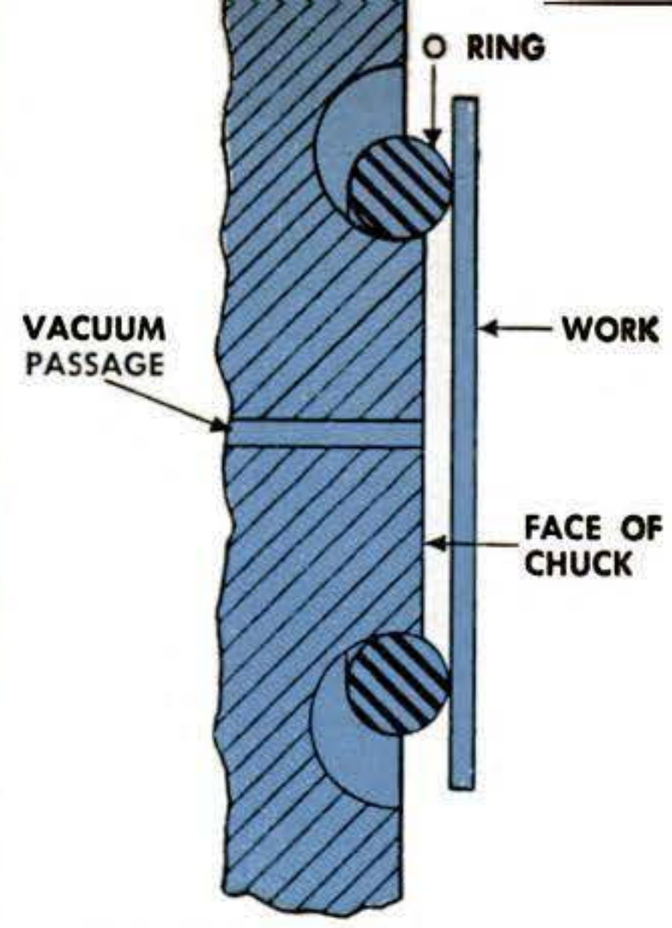
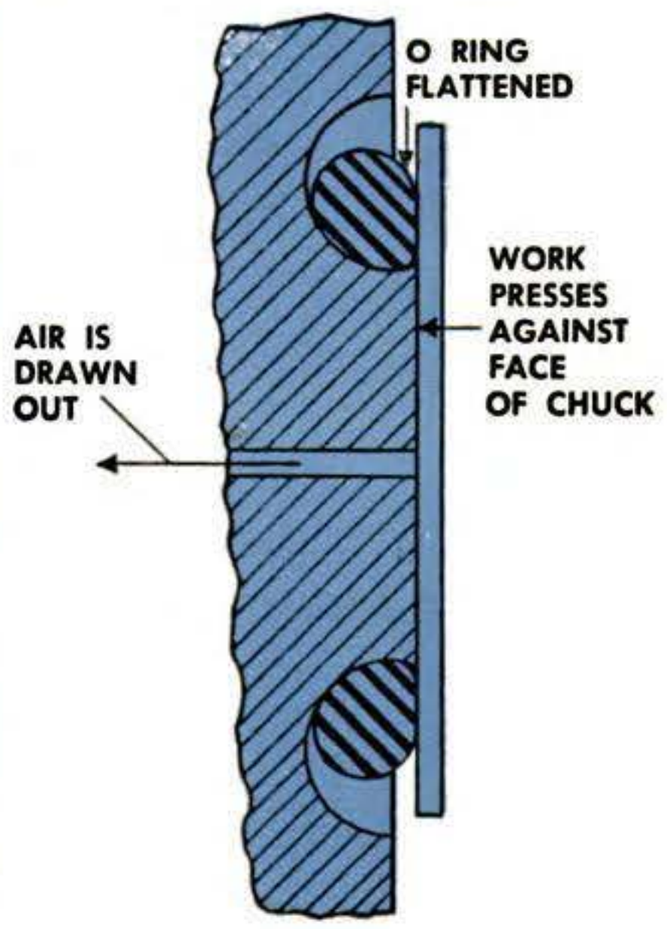




HOW IT WORKS: As air is pumped from behind the work, a vacuum forms within the rubber O ring. Even rough-sawed pieces like the one at left can be held securely. Atmospheric pressure rams the work against the O ring, flattening it (as below) so that the work bears firmly against the chuck.



New Vacuum Chuck Has Iron Grip

THE pull of air through this new vacuum chuck seems to have no more power than a small boy sucking on a soda straw. Yet the chuck holds materials in an unbreakable grip.

Plastics, brass, aluminum, copper, monel and titanium—impossible to grip with a magnetic chuck—are all held securely. Atmospheric pressure forces the work firmly against the chuck's face when a vacuum pump draws air from between work and chuck. Fragile materials, thin disks or shapes that can't be safely held in a lathe chuck or faceplate are simply placed against the vacuum chuck and locked in place by pushing the button that actuates the vacuum pump. For example, the chuck is used to

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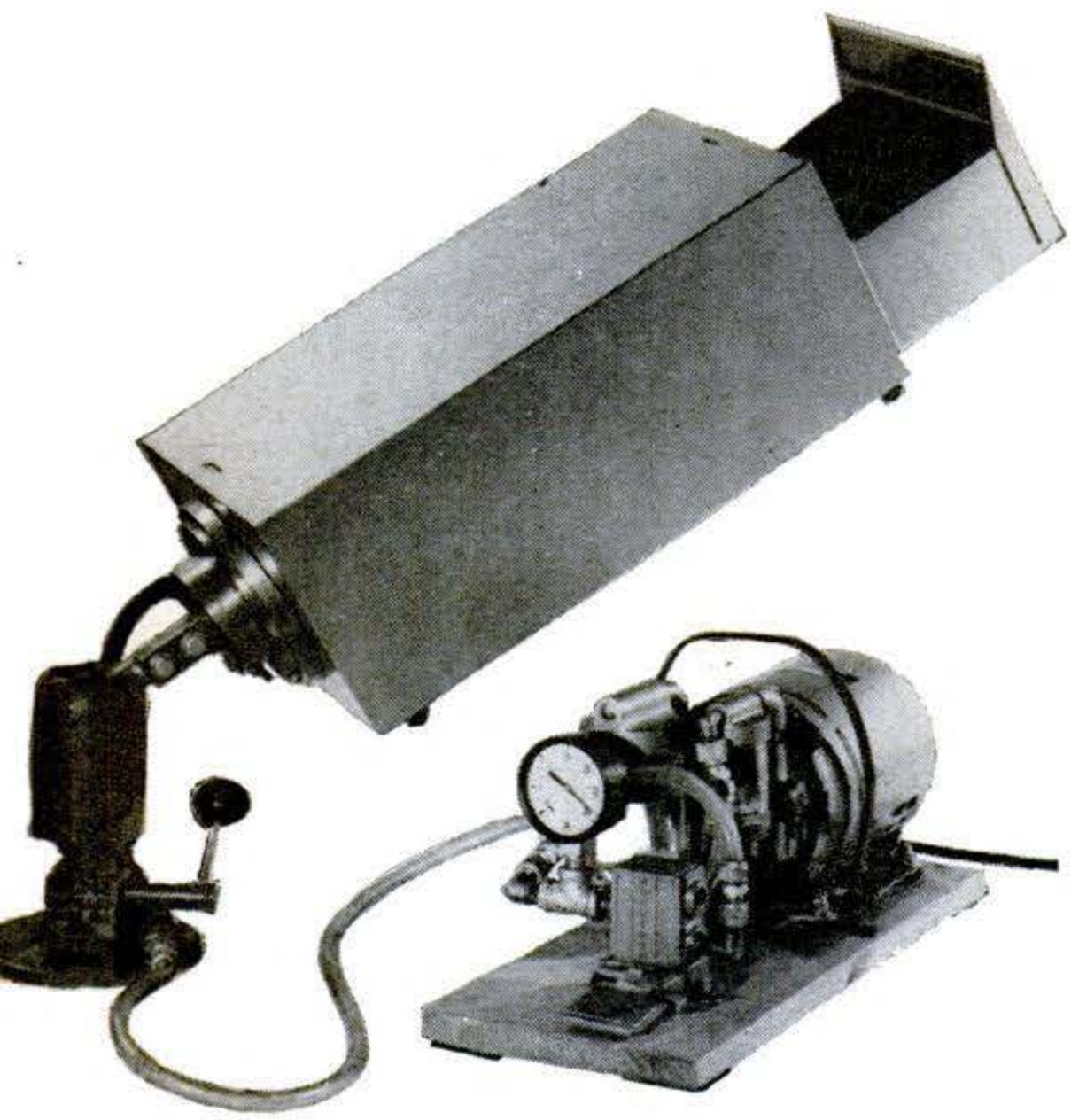

VISE-LIKE GRIP of vacuum holds outboard load of a heavy steel file. Vacuum pump pulls 29" of mercury; is so sensitive that its suction varies with rising or falling barometer.

grip thin aluminum disks while they are faced to precise thickness to become the rotating motor disks in electric meters.

If the work has a hole in or near its center, work is gripped by plugging the center port in the chuck plate and opening another port between two adjoining O ring grooves. The air is then drawn out to create a band or circle of vacuum near the edge of the work, which holds it securely.

The inventor, George F. Brewster of Kittery, Maine, developed the device from the suction-cup principle. But there is no mushiness or variation in the setup as there might be with rubber alone holding the work.

The chuck can be installed on a bench as a multi-position vise, or on a lathe or surface grinder. On lathe installations, a rotating seal in the vacuum line maintains the vacuum while the chuck spins. Special chucks can be designed to grip odd-shaped castings as long as it is possible to create a vacuum seal somewhere behind the work. Installations to fit specific needs are made by the Sherman Tool & Die Co., 7 Sherman St., Charlestown, Mass.

New Popular Science feature makes it easy for you to

HOME repairs these days come high. To keep down the costs, you must make the repairs yourself. It never pays to have a professional do a minor job, even if he is available. A plumber must charge you for his travel time to and from your home as well as the few minutes he spends fixing a dripping faucet.

Beginning this month, POPULAR SCIENCE will present a monthly data sheet on an upkeep job that periodically faces a homeowner. This month the subject is faucet repairs; next month, patching plaster. Each month's data sheet will solve another home-repair dilemma.

All of this handy information will be presented in each issue on two pages, back-to-back. Cut out this one sheet, along the dotted line. Then insert it as shown below in a loose-leaf spring binder for future reference. (If your stationery store doesn't have a suitable binder, you can order binder 107-A from Elbe File Co., 411 Fourth Ave., New York City.) Or punch holes in the sheet as indicated, apply hole reinforcements and keep it in a ring binder. By the end of the year, you will have your own valuable Fix-It File of common home repairs.

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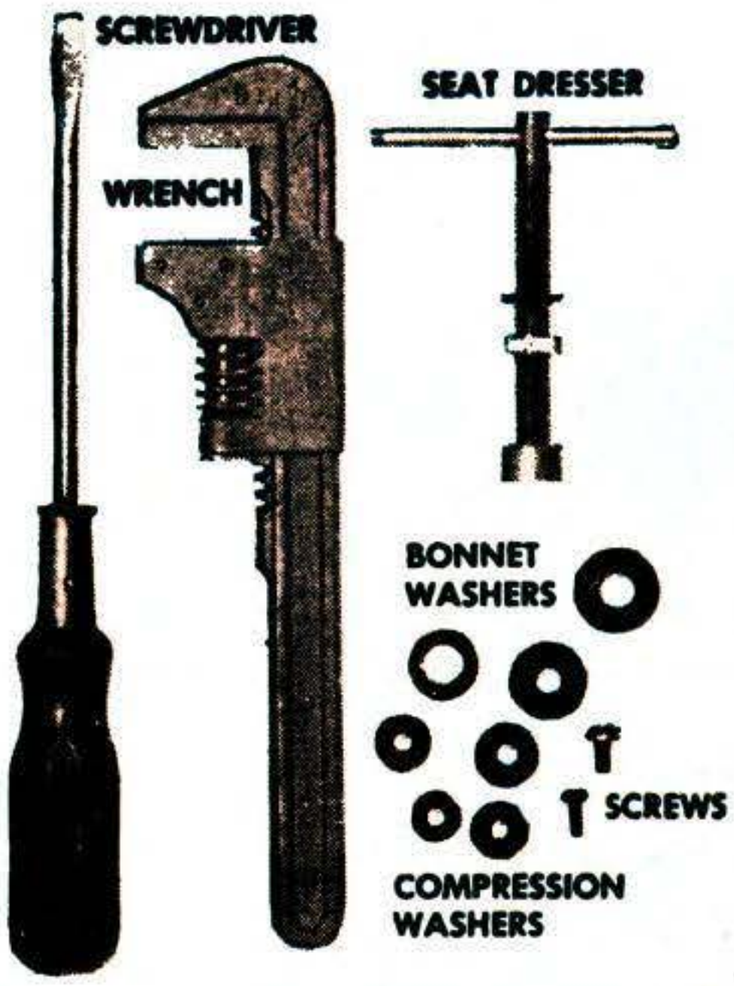
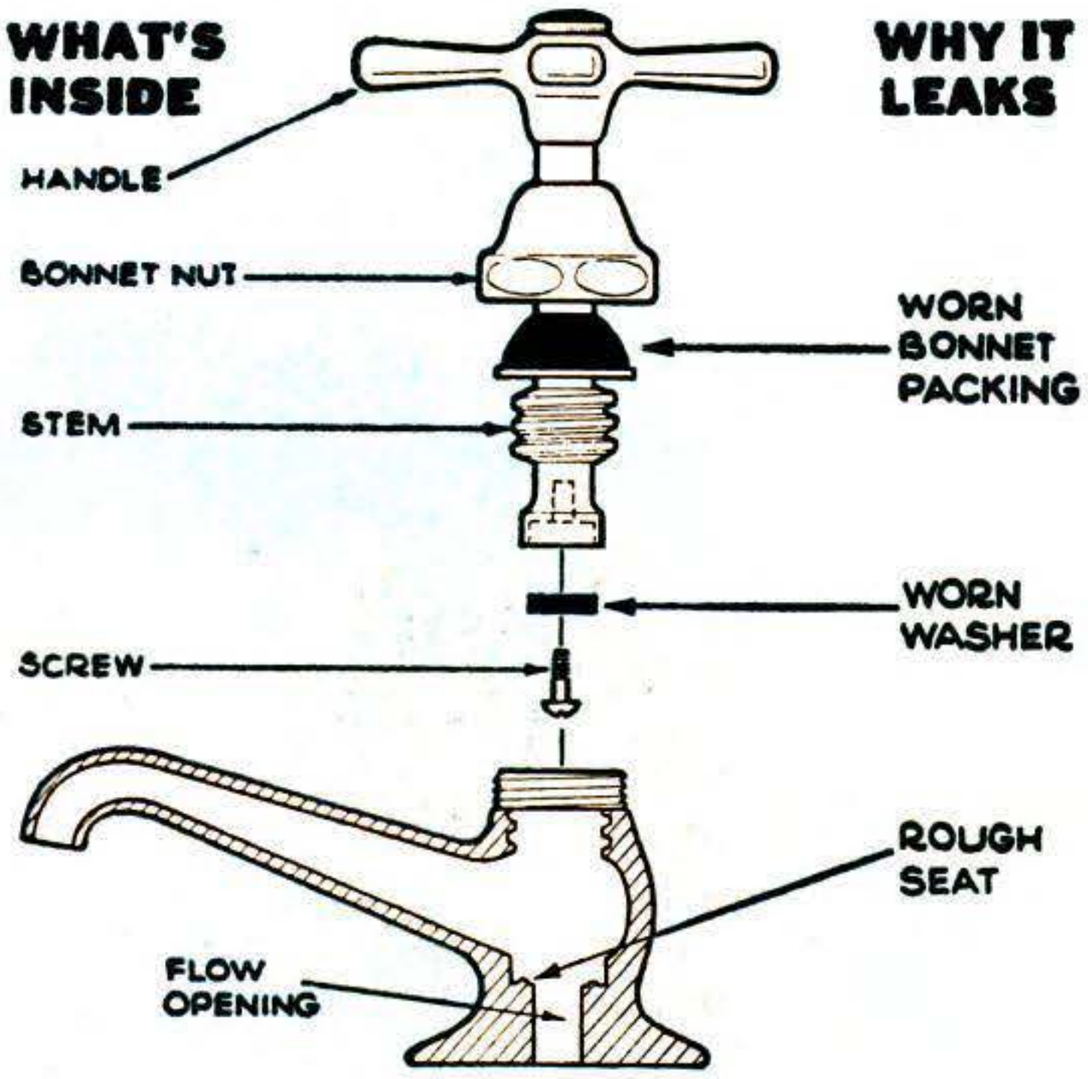
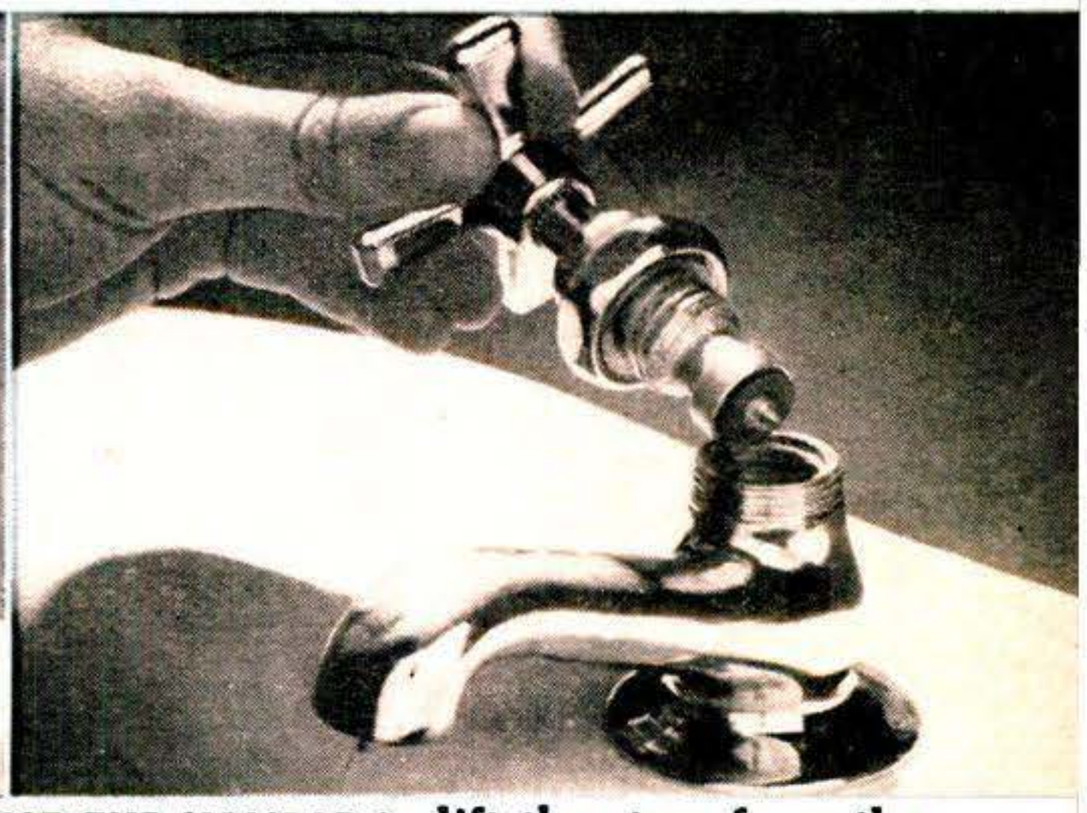
Popular Science Fix-It File





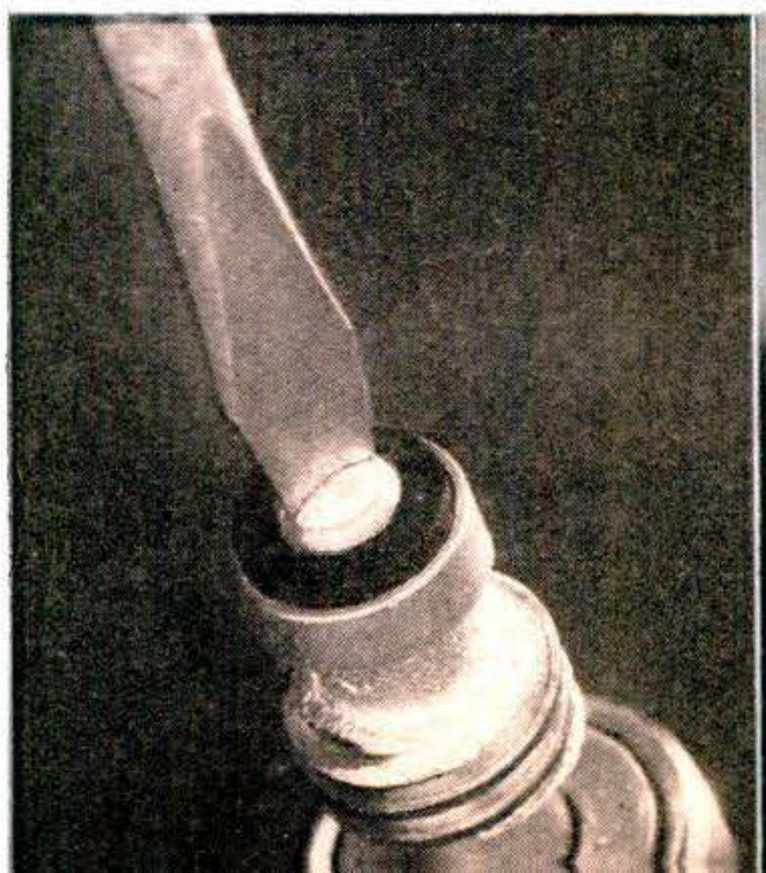
1 *How to replace a washer*

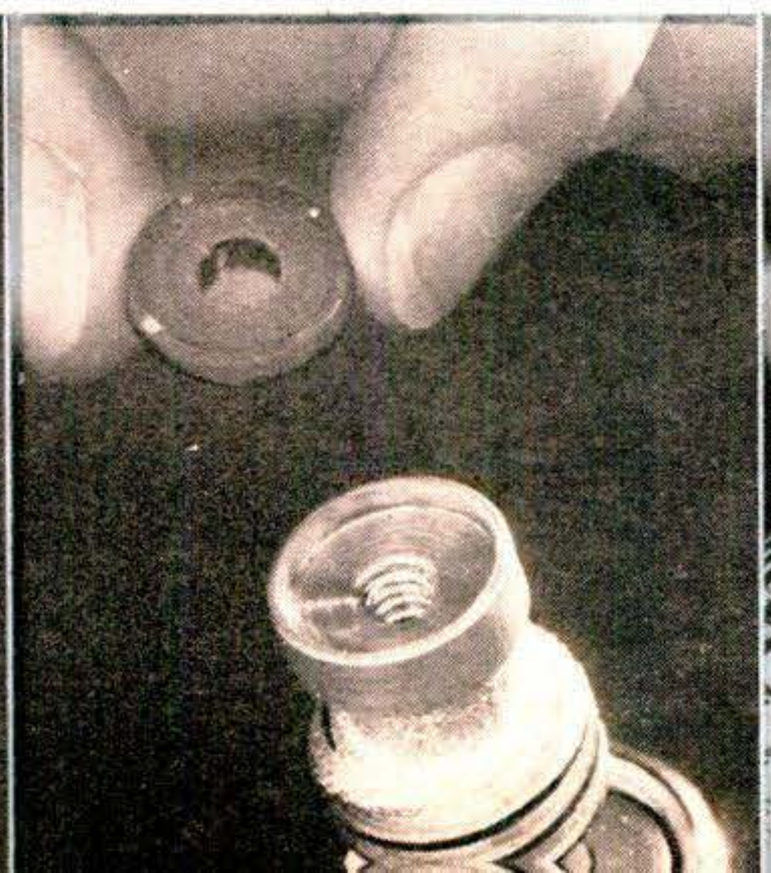
UNSCREW BONNET NUT with smooth-jaw monkey wrench after closing the shutoff valve under the sink or in the basement. Wrench might mar chrome; protect it with a cloth.

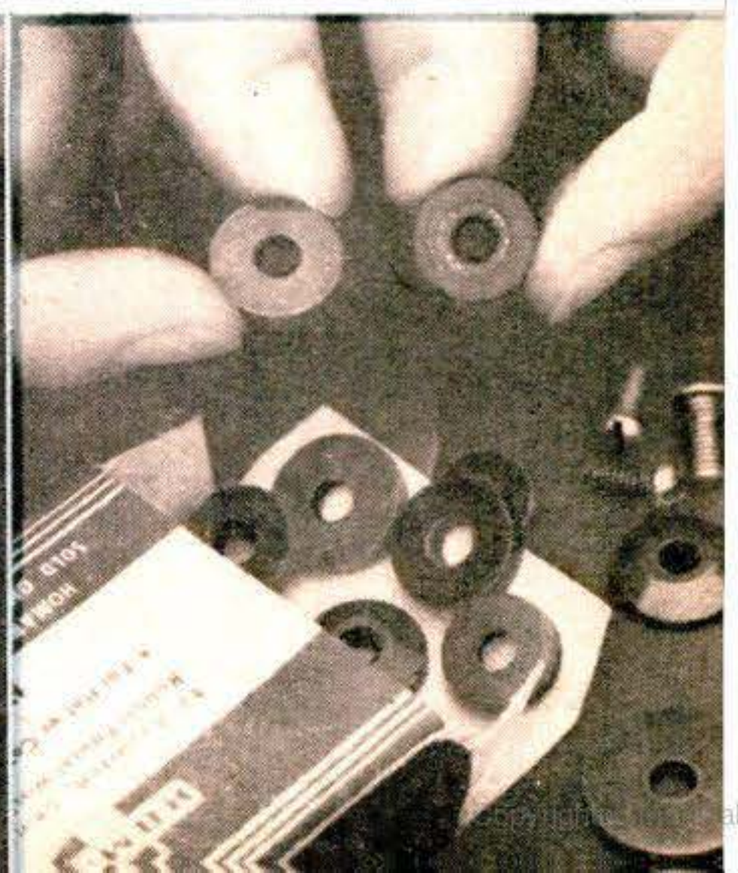


TWIST THE HANDLE to lift the stem from the faucet. On the hot side, twist it counterclockwise; on the cold side, clockwise. Stem, bonnet nut and handle will come off together.

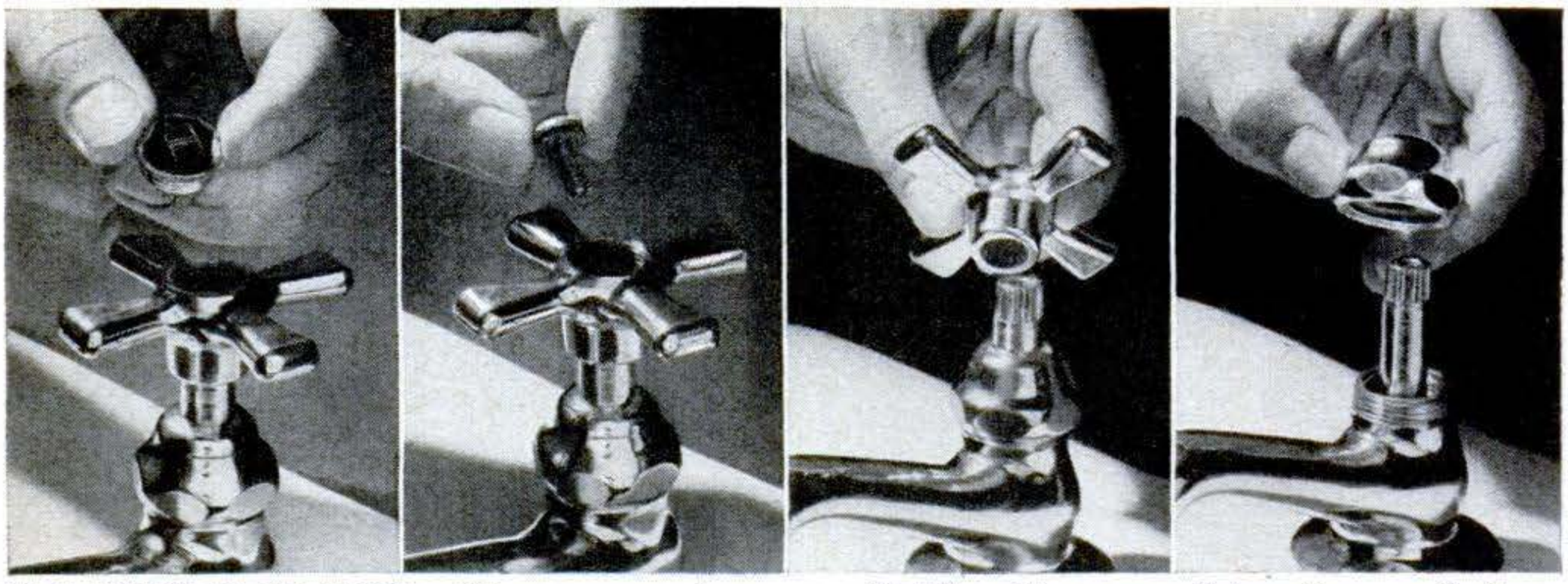
REMOVE THE SCREW that holds the washer in place. If it's frozen or the screwdriver slot is chewed away, use cam-lock pliers to loosen its head. Pry the washer loose and lift it out of the recessed end of the stem. Select a new washer (either red or black is okay) of the same size. It's usually best to install it with a new screw. Twist the stem into the faucet, and tighten the bonnet nut until the packing compresses on the stem, causing the stem to drag slightly when it's turned. Open the shutoff valve and try the faucet several times.



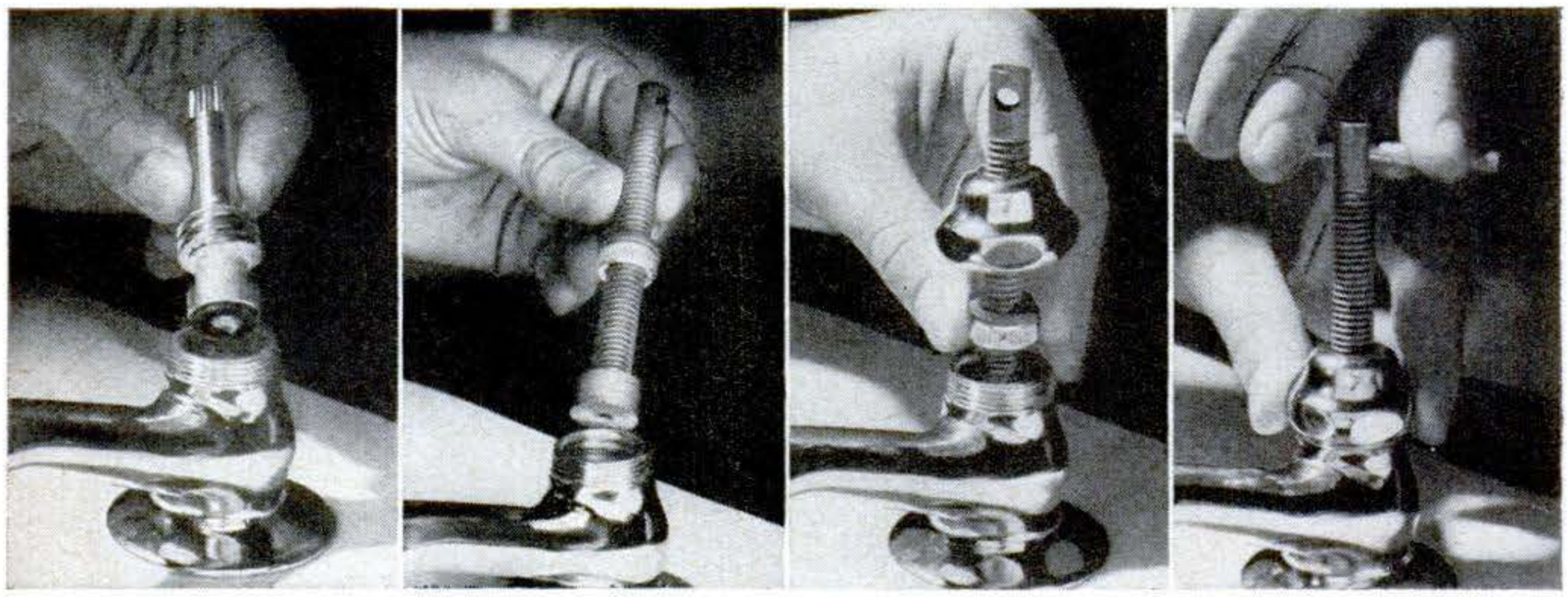




2 How to smooth a valve seat

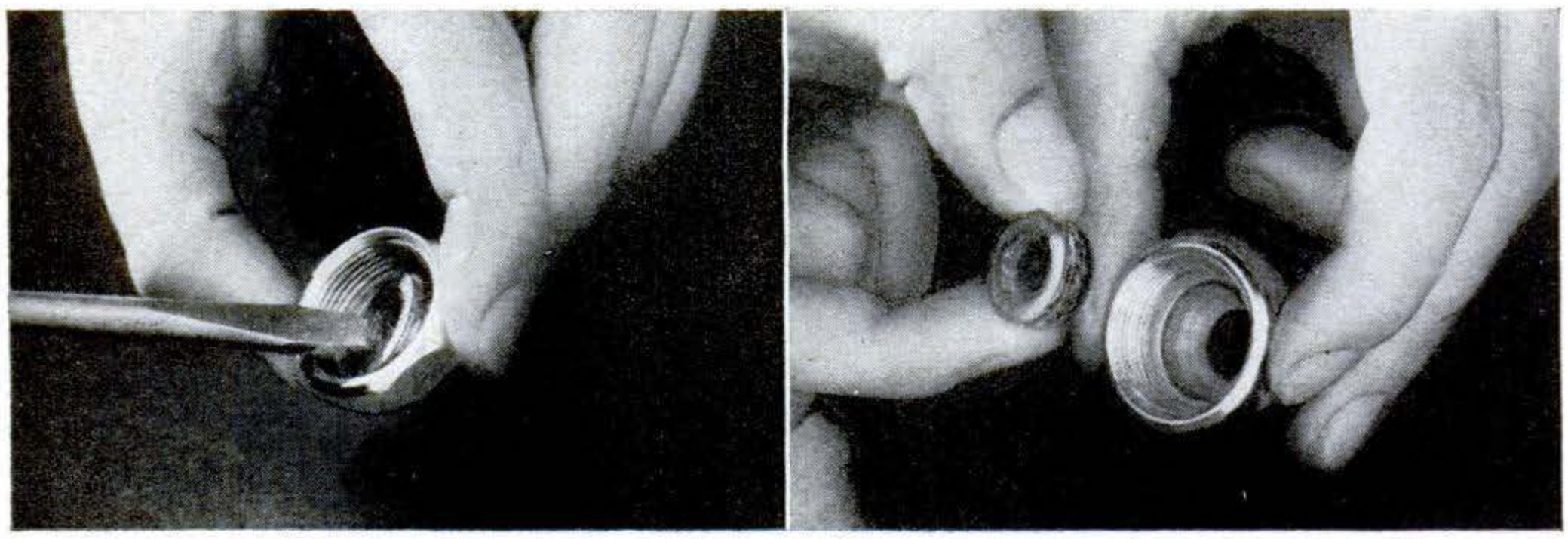


IF A FAUCET STILL DRIPS with a new washer, the seat may be rough or nicked, and needs smoothing. Unscrew the handle's escutcheon (if there is one), remove the setscrew that holds the handle on the stem, and lift it off the serrated shaft. If the handle sticks, tap it up lightly with a screwdriver. Loosen the bonnet nut and slide it up off the stem. Don't twist it off—serrations on the stem might enlarge the hole in the bonnet nut's packing washer, allowing water to ooze up around the stem when the faucet is turned on.



A FAUCET-SEAT DRESSING TOOL, costing under a dollar, will do the rest. After you've twisted the stem out of faucet (far left), insert the tool (second photo) until its cutting head bottoms. Adjust knurled nut on tool shank so bonnet nut engages one or two threads on faucet base. Then turn bonnet nut to press tool down on faucet seat. Insert T handle. Turn tool clockwise and rotate bonnet nut with it to maintain cutting pressure as tool dresses seat. Now remove the bonnet nut and tool, and reassemble the faucet.

3 How to replace the bonnet packing



IF WATER OOZES UP around the stem when turned on, packing washer in bonnet nut is probably worn. Remove handle and bonnet nut; dig out old packing with screwdriver.

PRESS IN new gumdrop-shaped packing washer of proper size to fit the bonnet nut. Tighten the nut on the faucet until the stem drags slightly when turned, and replace the handle.

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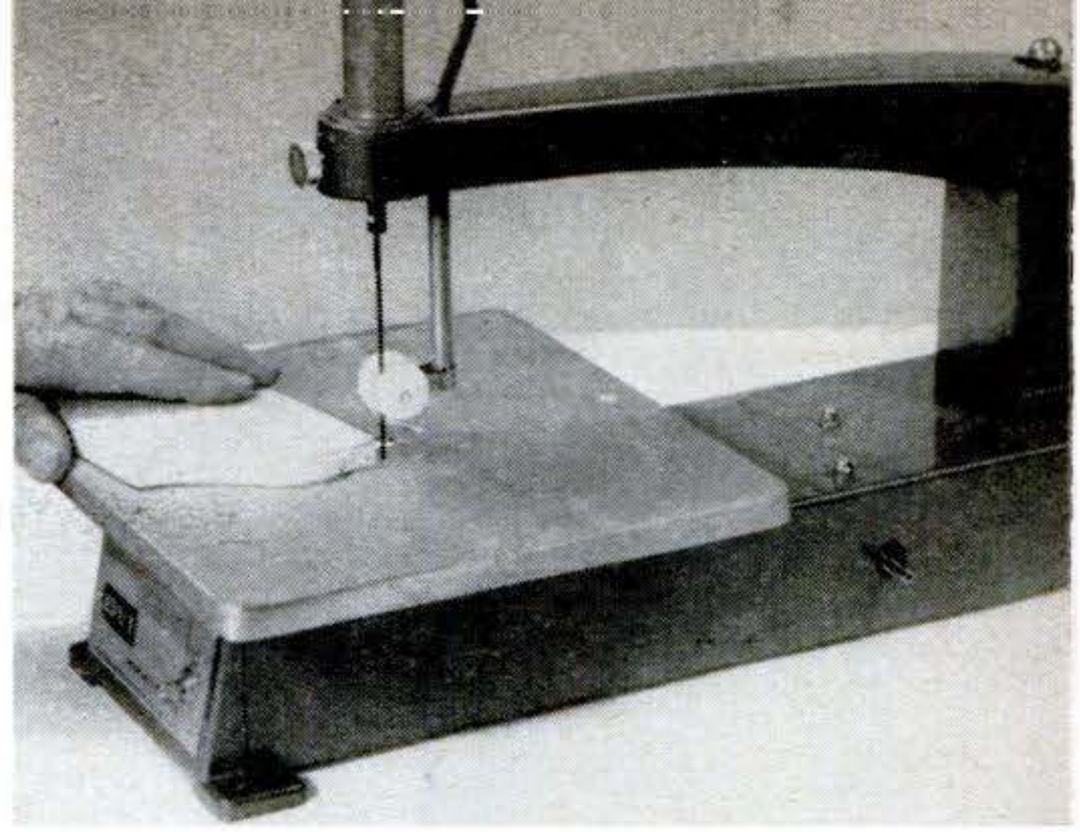
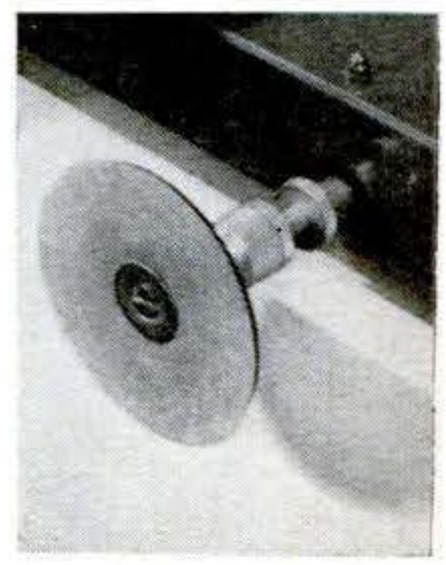
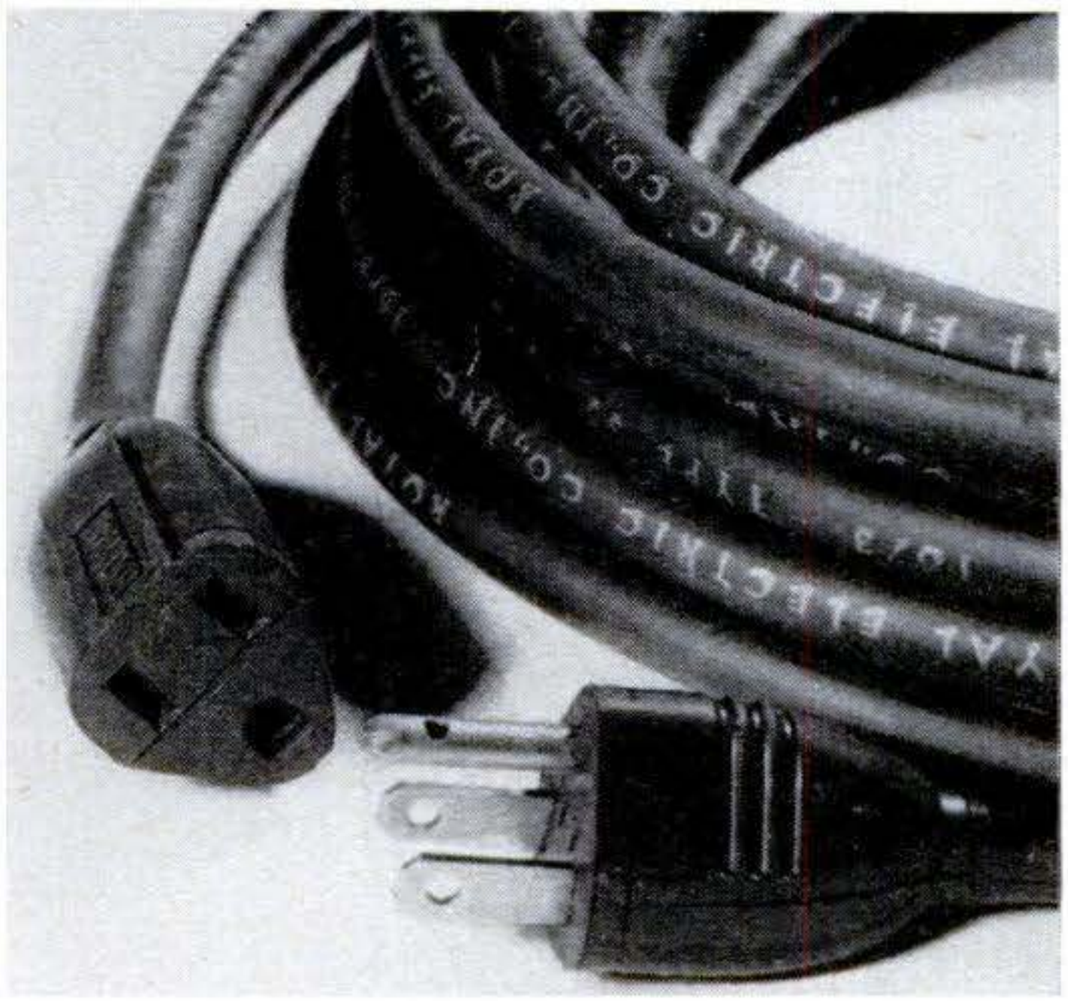
New Tools

1. Propane Torch Has Pilot Light. This new propane torch burns with a low pilot flame when you set it aside between jobs. A push button instantly switches to a high flame for heavy-duty brazing and other high-heat jobs. The pilot shuts off when the torch is not in use.

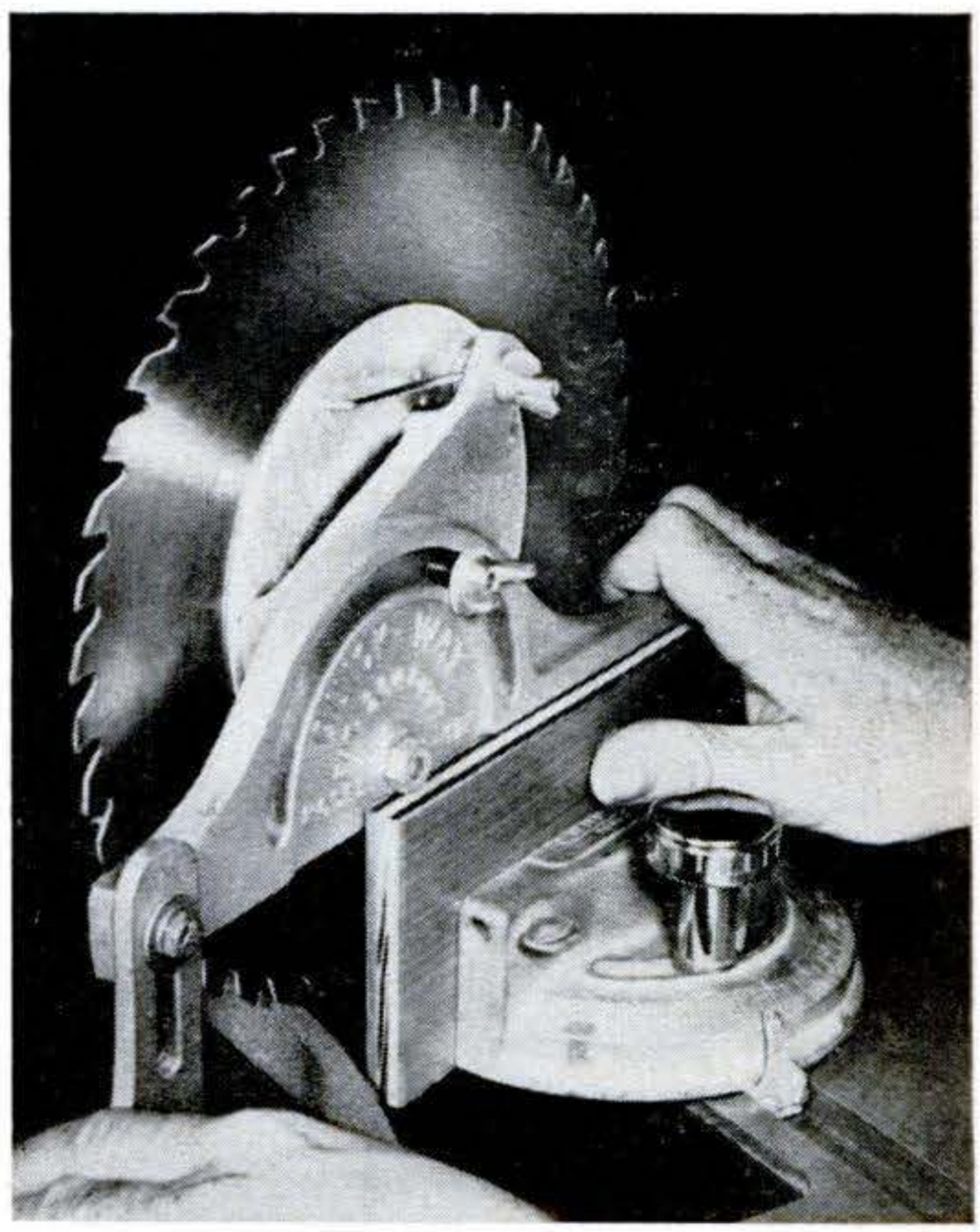




2. Multi-Job Jigsaw. This little saw is a jigsaw with the overarm in position, and a saber-blade table saw or disk sander with the arm removed. A power takeoff from a built-in motor spins at 3,000 r.p.m. You can attach a chuck that accepts ¼″ shanks for drilling, sanding, grinding, wire-brushing or polishing.



3. Extension Cord Has Built-In Ground. For use with tools having three-pronged plugs that ground them against shock hazard, this three-conductor extension cord maintains the continuity of the ground lead. With it you can use power safely out of doors or on damp ground.



4. Indexing Jig Sharpens Saw. Any table-saw blade up to 12″ can be sharpened accurately with this jig. You mount a special high-speed grinding wheel on the saw arbor, and the blade—in the jig—is passed over it. Two indexing plates cover the full range of saw teeth.

Please turn the page for more new tools

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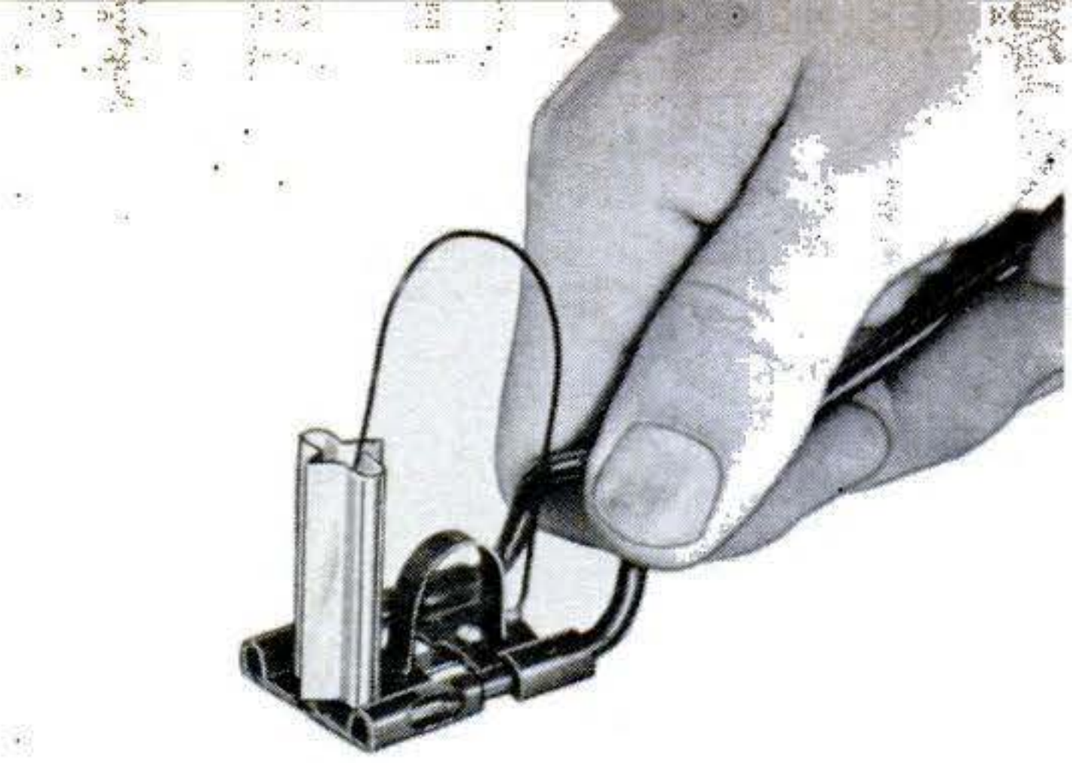
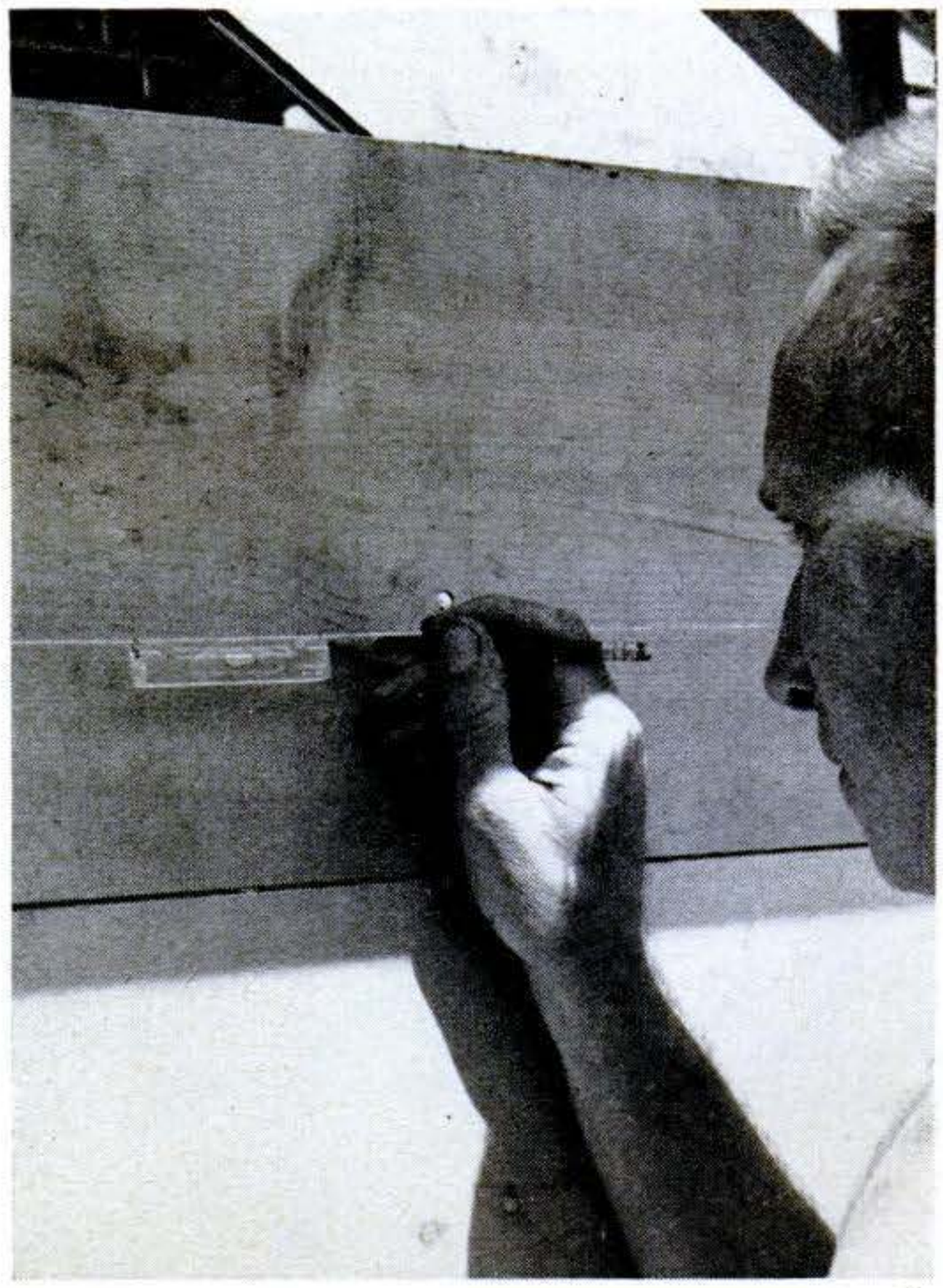
5. Axe Handle Is Bonded to Head. A new chemical process that does away with wedging now permanently bonds axe heads to their handles. It seals the eye, thus reducing absorption of moisture and minimizing shrinking at the joint—a major cause of loose handles.



6. Tool Drives Glazier's Points. Similar to a stapling machine, this tool lets you drive glazier's points in sash with one hand while holding the pane in place with the other. The magazine contains enough points for several windows. Refill points can be bought separately.

7. Brush Paints in Cramped Quarters. Painting under narrow shelves, boat seats and picket fences poses fewer problems when you use this brush. The swivel handle can be locked in any of four positions from in-line to right angle. The brush is made in 2″, 3″ and 4″ widths.



8. Tiny Level Rides String. A chalk line along a wall or a string tightened between stake markers doesn't sag from the weight of this 3″ line level made of transparent plastic and weighing only a half ounce. In use, you suspend it on the line by metal hooks mounted at each end.

More information *about the new tools shown on this and the preceding page can be obtained from: 1. Otto Bernz Co., Inc., Lyell Ave., Rochester, N.Y.; 2. Burgess Vibrocrafters, Inc., Grayslake, Ill.; 3. Royal Electric Corp., 95 Grand Ave., Pawtucket, R.I.; 4. Quick-Way Saw Co., 55 Tompkins St., Cortland, N.Y.; 5. Favette R. Plumb, Inc., 4837 James St., Philadelphia, Pa.; 6. Fletcher-Terry Co., P.O. Box R, Forestville, Conn.; 7. Wooster Brush Co., 609 Madison Ave., Wooster, Ohio; 8. Stanley Tools, 111 Elm Ave., New Britain, Conn.*

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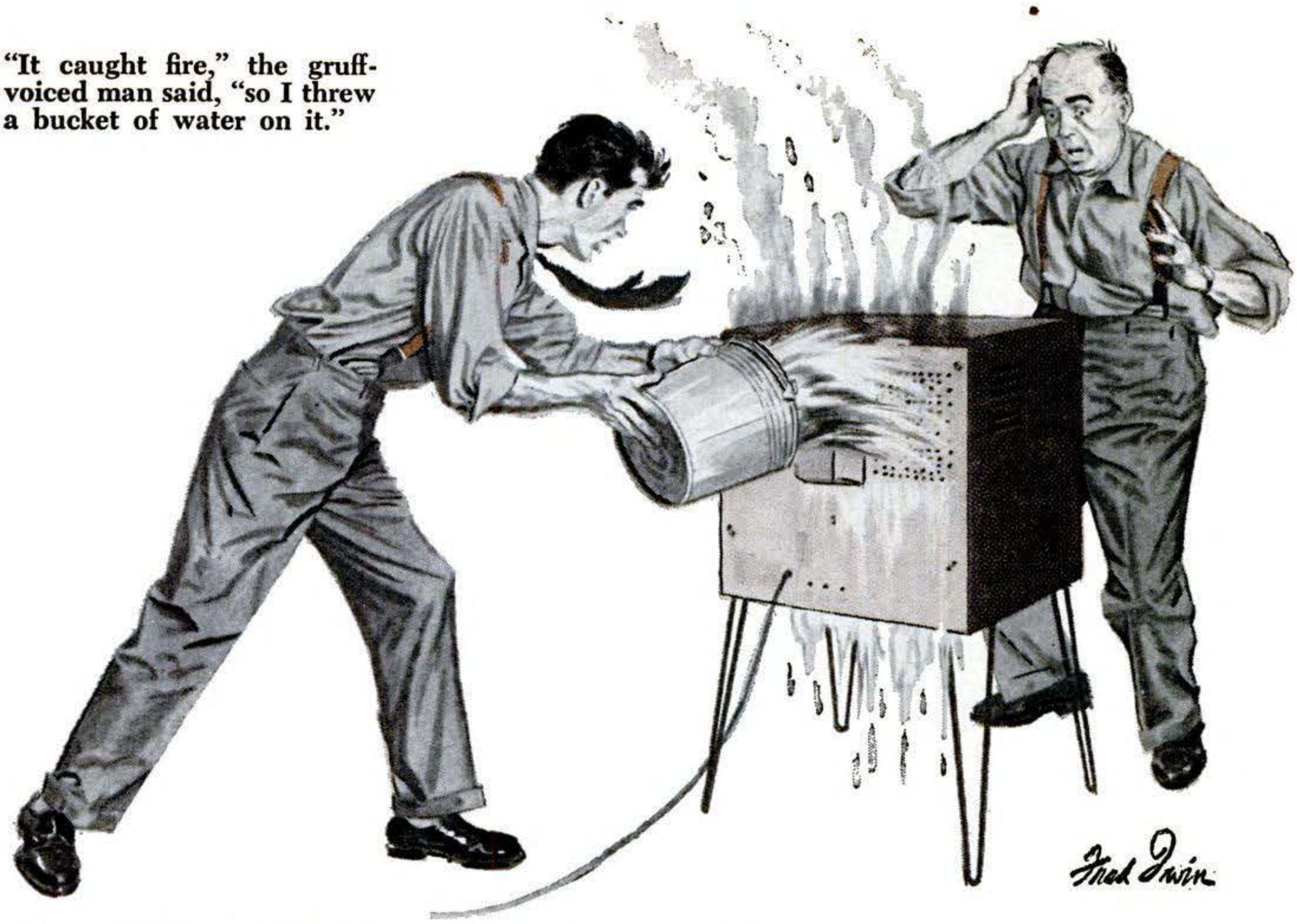

"It caught fire," the gruff-voiced man said, "so I threw a bucket of water on it."

Electricity on the loose can cause damage fast. It's the reason, says this repairman—

Why TV Parts Sometimes Burn Up

By Art Margolis

SOME of the meanest TV troubles are what I call cases of "electrocuted" parts—they receive so much electricity that they burn up. If you just put in a new part, it would go right up in smoke, too. This sometimes happens to the best repairmen, but it shouldn't. Customers aren't happy about seeing their bills go up with the smoke, and the repairman isn't happy if the cost has to come out of his own pocket.

As a TV repairman myself, I know. Whenever I spot a burned part, I figure that something must have made it burn up. Somewhere in the set unwanted electricity is on the loose. I replace the part, but before I turn the set back on, I check to make sure that the real cause is corrected. If it isn't, one new part after another would keep right on burning up.

In these electrocution cases, the damaging electricity is usually found in what is called the B-plus string, though in rare cases it can be hidden anywhere in the circuit, causing harm by remote control. Tracking down this electricity can be troublesome—and often the trouble isn't only with the set, as I'll tell you.

Smoke Without Fire

ONE day two men came into my shop carrying a set that was soaking wet. When I asked what had happened, a stocky, gruff-voiced man said, "It caught

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fire so I threw a bucket of water on it. Fix it up and call me when it's ready." He wrote down his telephone number and the two disappeared.

Using an electric heater, I dried the set out, then turned it on. Sound came but no brightness. I saw that the horizontal output tube was running with cherry-red plates. In seconds, smoke spewed out from a resistor in the anode circuit of the tube. I let the set cool, then turned it back on for 10 seconds and took some fast voltage readings.

One reading was at the anode where the resistor was attached. It was supposed to carry a B-plus of 400 volts. It read 50 volts. The voltage on the other side of the resistor was correct, over 400 volts. That meant 350 volts were being dropped in the resistor.

There were two possibilities. If the resistor had increased in ohmage, it would drop more voltage than it should. I tested the resistor, and it measured 8,000 ohms, as it should. That eliminated that.

The voltage could also drop if too much current were being drained through the resistor, which could happen if there were no control from the tube's control grid. This control, called bias, has a faucet effect on the tube's electron flow and is supplied to the horizontal output grid by the preceding stage, the horizontal oscillator.

I found no bias on the control grid. Sure enough, the oscillator wasn't running. I located a coil that had opened up and replaced it. The oscillator fired up, the output grid received bias—and the tube and resistor stopped burning.

When I called the set owner's number, I felt that I should enlighten him on what to do if a TV seems to be on fire.

"If you ever have a little smoke again," I said, "don't get scared. Don't throw water on a TV set except as a last resort. The parts usually won't burn of themselves. They only smolder when too much electricity is pumped through them. Usually all you have to do is pull the plug out."

Somehow, the customer didn't seem grateful for my advice. He snorted, "Look, wise guy, just deliver the set."

I couldn't understand why until he gave me the address. It was the volunteer firehouse.

The Midnight Chase

I WAS returning home from delivering a set one late Saturday night when a large sedan bore down fast on my truck and pulled alongside. The driver motioned for me to stop. Even in the dark, he didn't look like the law, and since I had about three days' receipts in my wallet, I decided to make a run for it. I hit the accelerator, and for awhile had the lead. Then on a wide stretch he careened ahead and blocked me off. I screeched to a halt and reached for the tire iron.

As the man approached, I began to work up a hearty dislike for people who keep servicemen out until the middle of the night—like the delivery from which I was now returning.

It had been one of those stickers, too, a real sick chassis of an older model, vintage '49. When I first turned it on the picture appeared, then started to shrink from all sides. There was some popping, the picture disappeared, and smoke poured from the horizontal centering and focus controls. Both were badly burned.

Centering and focusing of a TV picture is done by influencing the picture tube's ray with fields of force. In today's TV sets, these fields are derived from permanent magnets and electrostatic charges.

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In this older set the fields were made with electromagnets. The horizontal centering control varied the electromagnetic field in the horizontal yoke. The focus control varied the electromagnetic field in the focus coil. Both controls did this by being variable resistors in the path between the TV's power supply and the electromagnets.

Since these controls were burning, it meant that too much electricity was passing through them. But why? By turning on the set for 10 seconds at a time I was able to make voltage readings with my vacuum-tube voltmeter before it began smoking. I found a condition that's really rare.

House current enters a TV set at about 117 volts AC. The power transformer takes the 117 volts and steps it up to about 350. Then a rectifier and filter network transform the 350 AC into 350 DC. This 350 DC is called B-plus.

When I read the voltage output of the power supply I found, instead of the 350, over 600 volts! A few turns of the transformer primary had shorted, so instead of the transformer stepping the 117 to 350, it stepped it to over 600. All that extra electric pressure pumping through the controls was literally electrocuting them. A new transformer plus changing the controls cured the condition.

But this wasn't half the trouble that I then got into—out there on that lonely road. The man was running toward me. I gripped the tire iron tighter. Suddenly he crossed into my headlights and I saw him—the customer I had just delivered the set to. I tried to think what I could have done wrong.

"You're a hard man to catch," he huffed, holding something out to me. "You dropped your wallet under the set."

The Set That Starred Germs

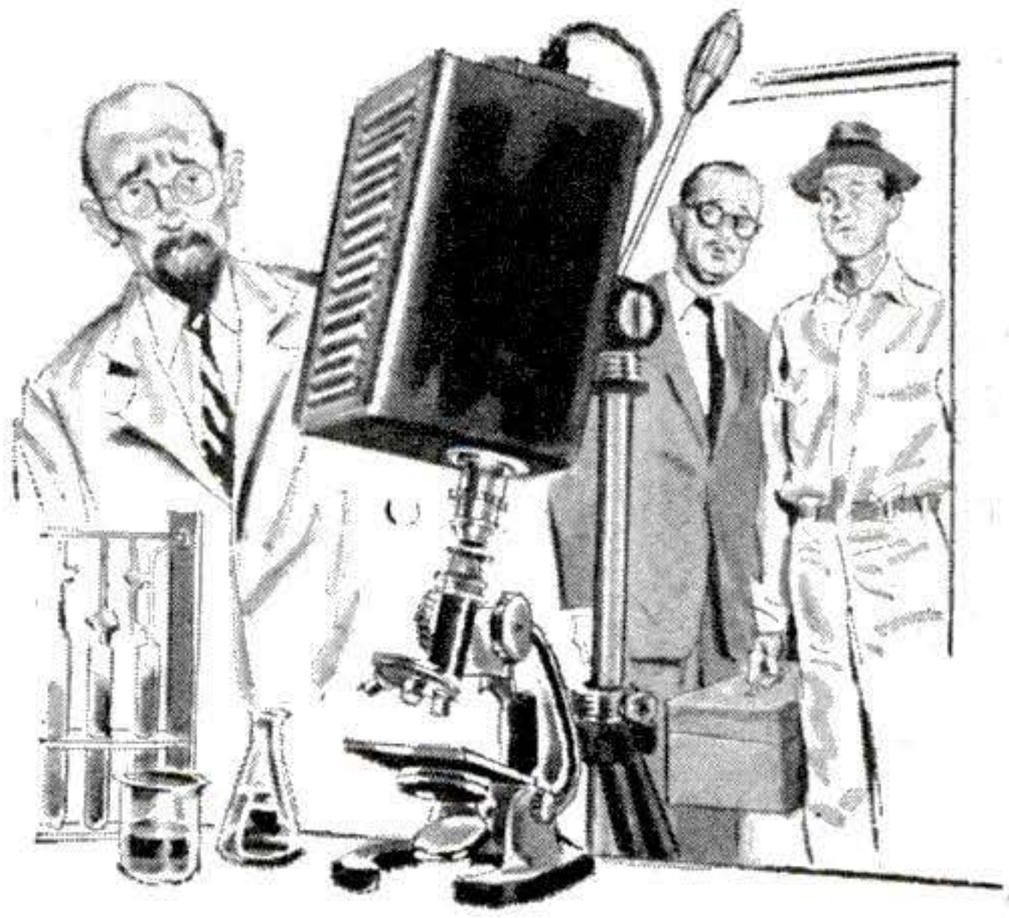
DOCTORS at a nearby medical-research lab use a TV camera and a 21″ monitor set to peer into the private lives of bacteria under a microscope. On the day that I was called there, the bacteria were performing without an audience because the screen was blank. It showed light but no picture.

One thing was easy to spot—a charred, electrocuted resistor. As I replaced it, one of the doctors who seemed interested in electronics peered over my shoulder.

"Burned-out resistor, huh?"

I nodded, but already my instruments had told me something else. There was no B-plus voltage on the anodes of the tubes to attract the tubes' electron flow. I went to work.

The doctor looked puzzled. "Now



what? You've already changed the resistor. Isn't that all?"

I tried to think of something to ask about bacteria, but couldn't. Using the ohmmeter, I checked the resistance from the anodes to zero potential (chassis ground). Instead of a high resistance, I found a very low resistance—a short.

A condenser attached from a 350-volt B-plus point across to zero volts had shorted. The 350 volts was being dumped out through the short before it could get to the anodes. The resistor was in the path of the onrushing B-plus and had no choice but to become electrocuted.

I pointed to the condenser. "There's your real trouble, Doctor. With no B-plus on the anodes of the tubes, you got no picture. You see, the resistor was only the symptom, not the cause."

When I had replaced the condenser, sending the B-plus to its proper destination, a soundless scene of slowly oozing

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life reappeared on the screen. The doctor beamed. I said I didn't think it would ever replace Marilyn Monroe, but he didn't seem to mind a bit.

The Girl I Left Behind

SOMETIMES a TV part dies of slow electrocution. Instead of burning up immediately, it receives a small amount of lethal electricity at a time, until finally it has to give up. This is what happened to a set whose owner will not be calling me for service any more.

The last time I was there, an unsmiling, stocky woman ushered me into the living room where sat her daughter, a carbon copy of the mother, but 20 years younger. Her name was Rosalie.

I went to work on the TV. There was no video, only light and sound. I located a bad video amplifier tube and changed it. As the new tube heated, some video slowly came back on, but it wasn't too crisp. All the time I was working I was aware of the mother keeping up a steady stream of comments. "Be careful of the rug—do you own your own business—don't scratch the end table—my daughter could have married anyone she chose."

Since the video was not too good I checked further. The plates of the new tube had turned a slight shade of pink. It was drawing too much current.

When the 350 volts B-plus leaves the power supply, it goes to many anodes. Some of the anodes need the full 350 volts, others less. Resistors are thus placed in the pathways to drop some of the voltage. The larger the resistor is in ohms, the more voltage it drops.

For this particular anode, there was a 10,000-ohm resistor designed to drop the 350 volts down to 120. But the resistor had shorted down to 400 ohms, dropping the 350 down to just 320.

This excessive electrostatic potential really pulled the tube's electron stream to the anode. A lot more current flowed than the tube could stand, and that's why the plates lit up pink. In time the overworked tube would have burned up like its predecessor. I changed the resistor and the video came on clear.

The mother hadn't stopped for air, but as I was leaving she surprised me with a smile. I was trying to figure out why when I suddenly did a double take. The last thing she had said as she smiled was, "You'll pick up Rosalie at eight?"

How I Lost My Fee

SERVICEMEN frequently trade favors with friends and business acquaintances. Like Sam, the barber. He cuts my hair, I fix his TV. But here's one of the queerest deals I've ever made.

My wife, Lea, rode out with me one night to deliver a chassis to a large old house at 1209 High Street. As we entered, we were greeted by a roomful of people cavorting noisily to a loud tom-tom beat. What a party, I thought.

From the crowd, the set owner motioned me to install the chassis.

I had pulled the TV originally because

[Continued on page 232]

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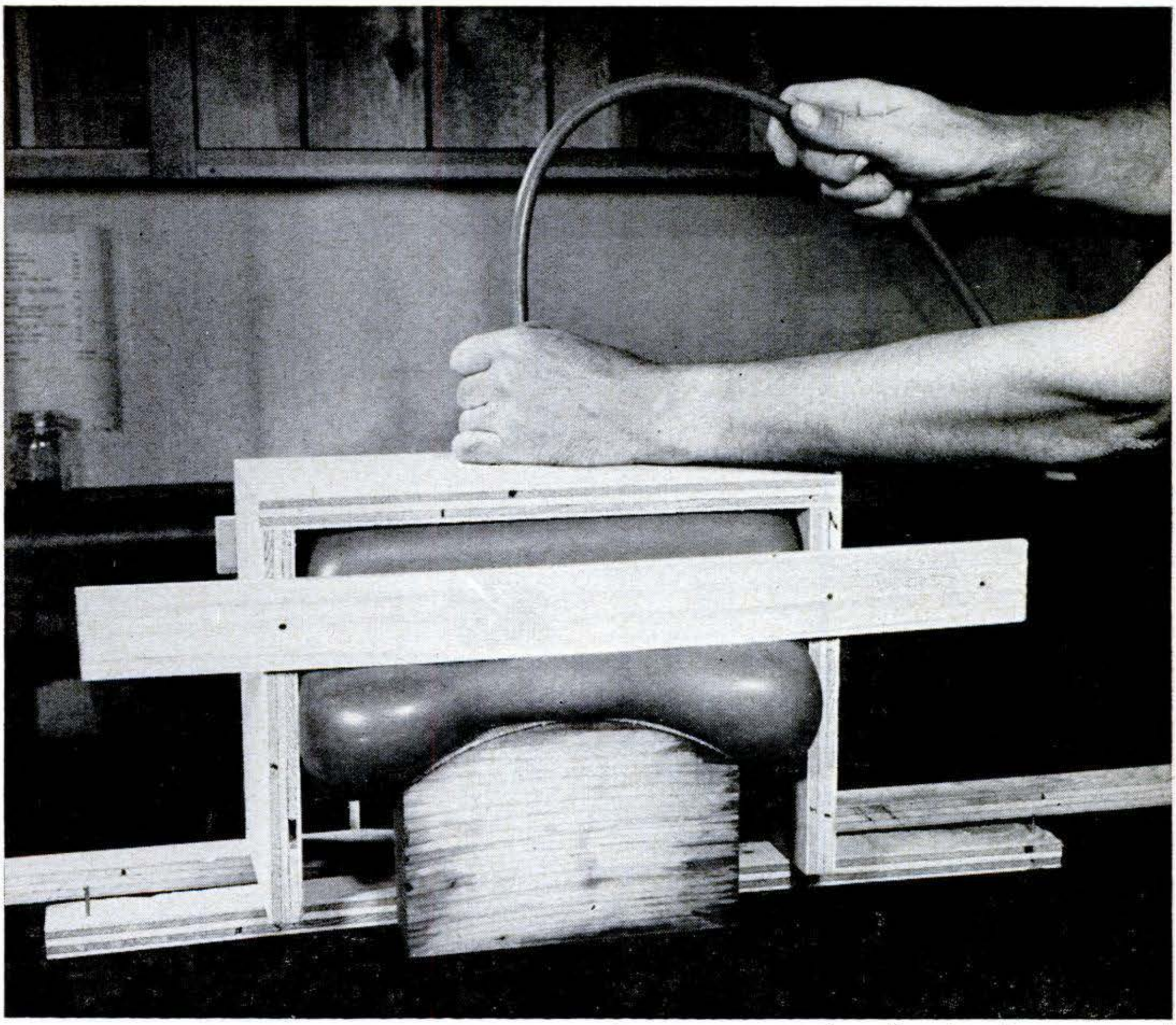

1 AIR PRESSURE is a clamping force not used as often as it might be. But each job will need a setup designed just for it. In this test setup a heavy balloon contains the air.

How to make 8 Problem-Solving Clamps

By R. J. De Cristoforo

YOU can buy a clamp to suit just about any woodworking problem. The trouble is that, for most of us ordinary guys, the expenditure isn't justified. We don't need the particular clamp often enough.

A homemade clamp or fixture may serve just as well. Some of the clamps pictured here will suit only one special job. Others are more adaptable; it'll pay you to make them because they'll become permanent equipment.

You can exert a lot of pressure and do a lot of holding with bolts, turnbuckles and the like. In making clamps, these would be your main stock in trade. But you ought to consider, too, what it's possible to do with air pressure and the weight of water.

I know one chap, for example, who had the problem of gluing a large sheet of veneer. He solved it neatly by putting a child's wading pool on top and adding water to provide uniform pressure.

Please turn the page for more clamp ideas

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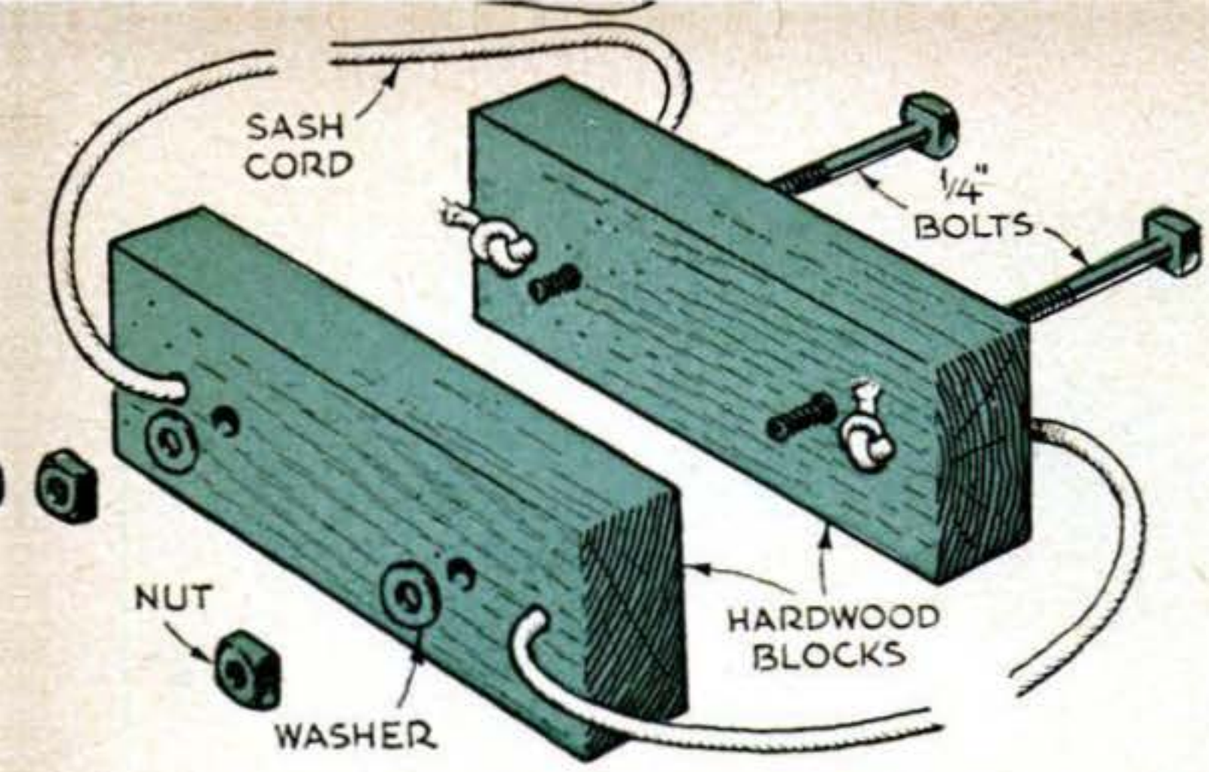
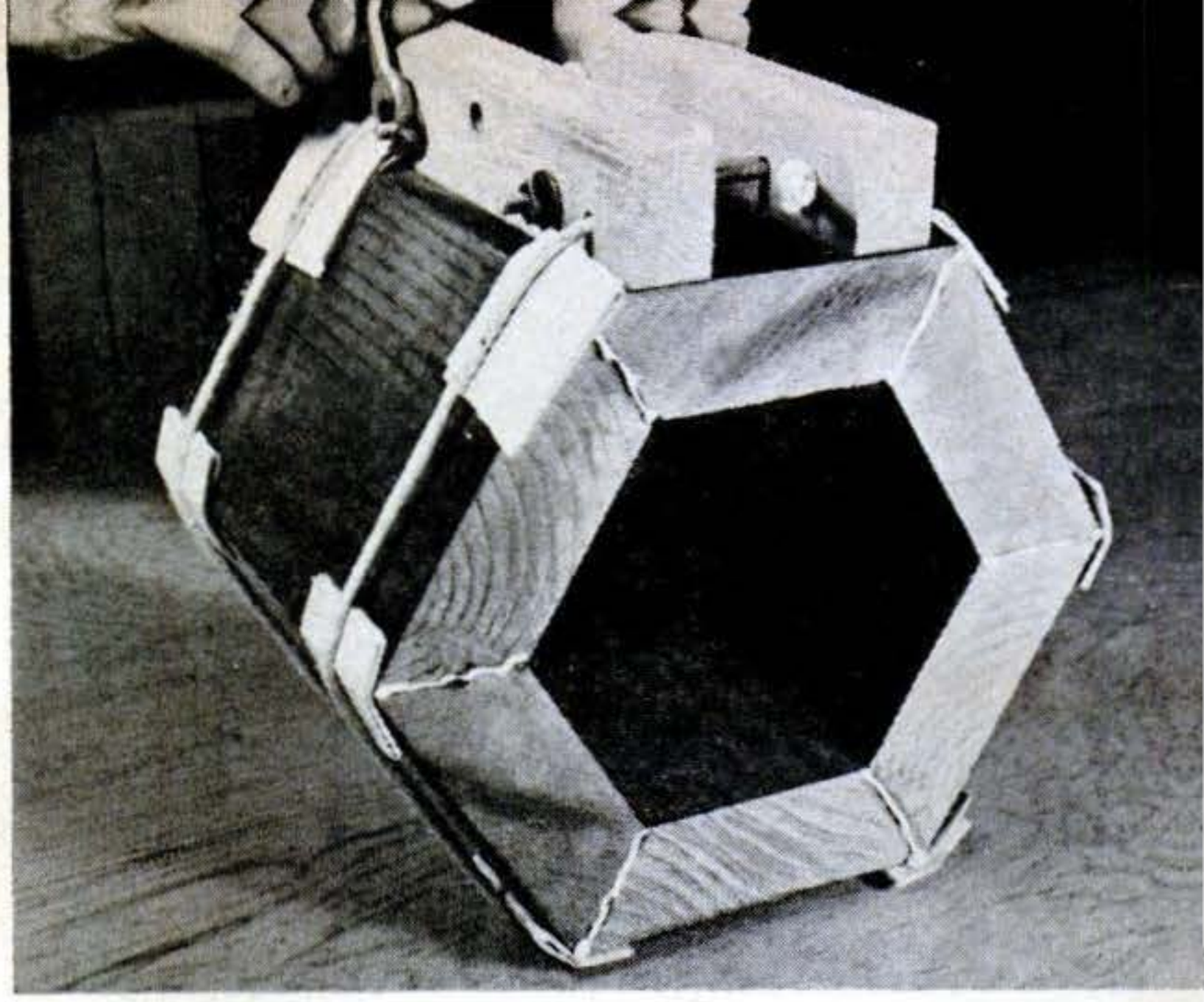
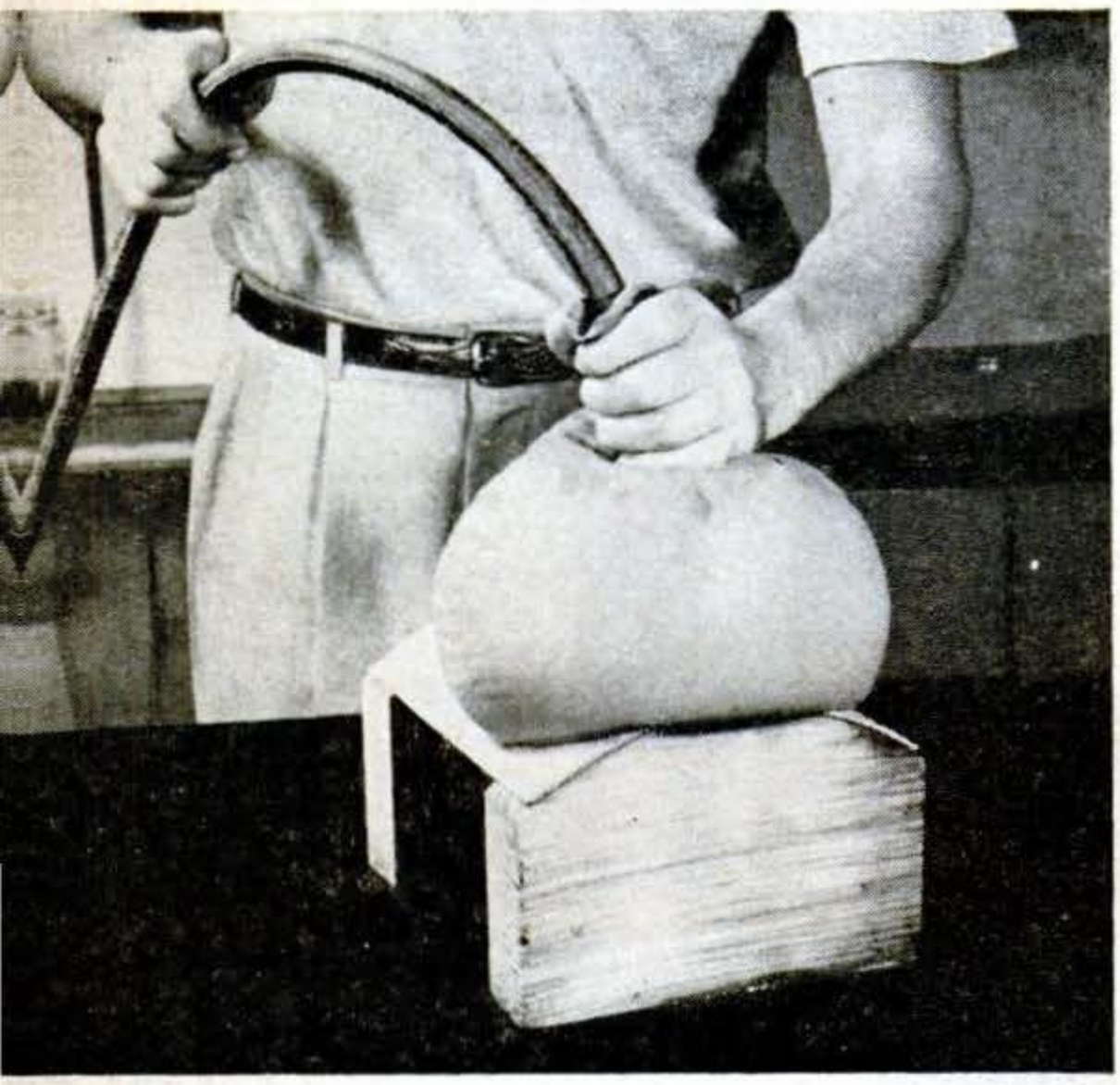
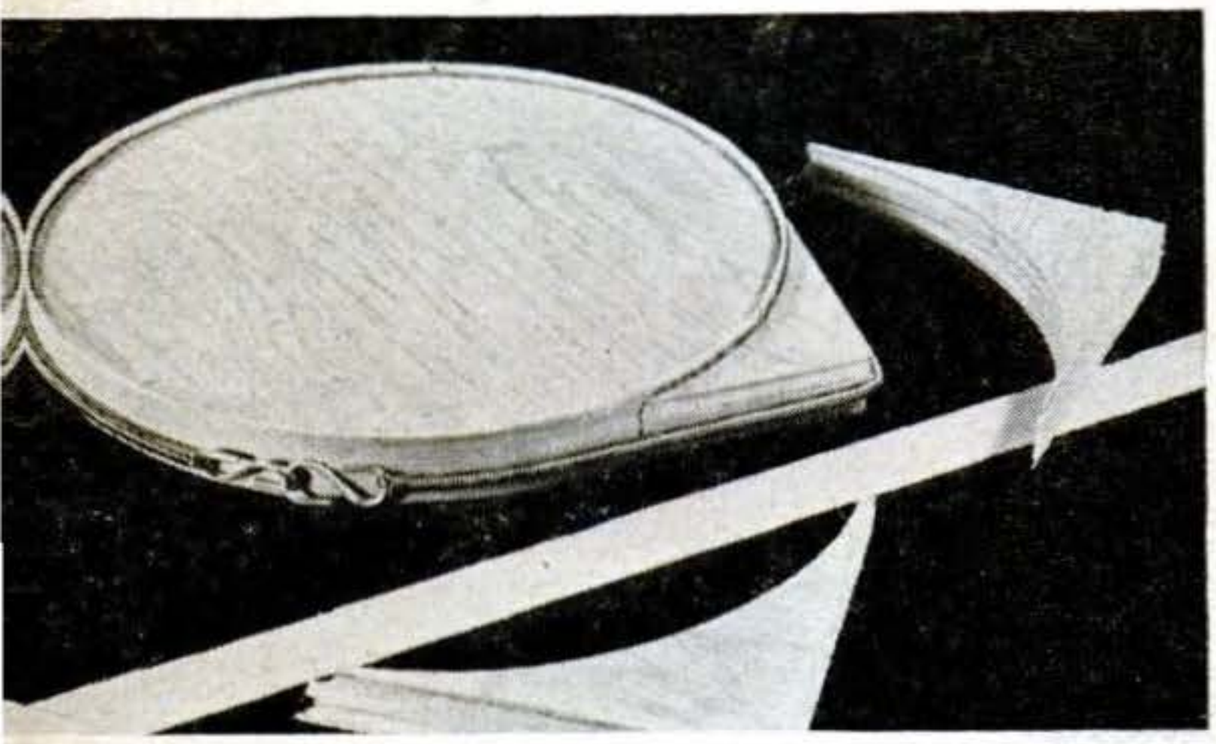


2 SASH CORD AND HARDWOOD BLOCKS, drawn together by bolts, are a practical, homemade method of clamping segmented shapes like the one at right. Cardboard under the cord keeps it from cutting the wood. Avoid using clothesline or anything similar. It stretches too much.

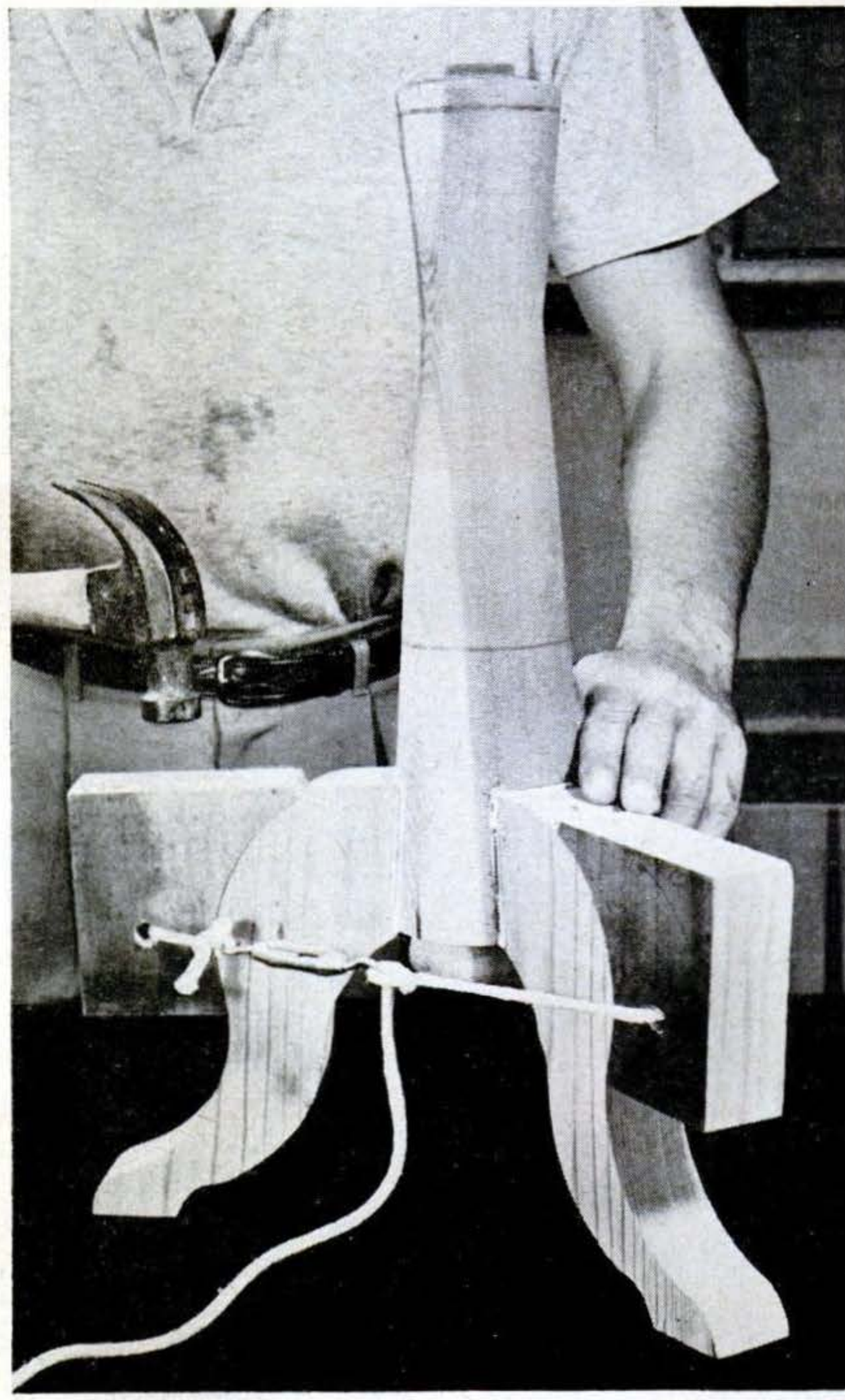




3 THE WEIGHT OF WATER can sometimes be used to apply clamping force. The problem is to contain the water. This setup shows how a large, heavy-duty balloon might be used.



4 BANDING A DISK with a strip of veneer edging is no problem at all. Cut the strip to exact length by a trial fitting on the disk, apply glue, and hold the strip in place with a long spring and two S hooks. A scrap corner of disk material holds the strip ends snugly in place.



5 LEG SCRAPS AND SASH CORD, tightened with a turnbuckle, solve the perennial problem of gluing legs to a round column. Set the scrap cutoffs high up on the arc of each leg, tighten cord, and hammer down each block as above until the mating faces are snugly together.

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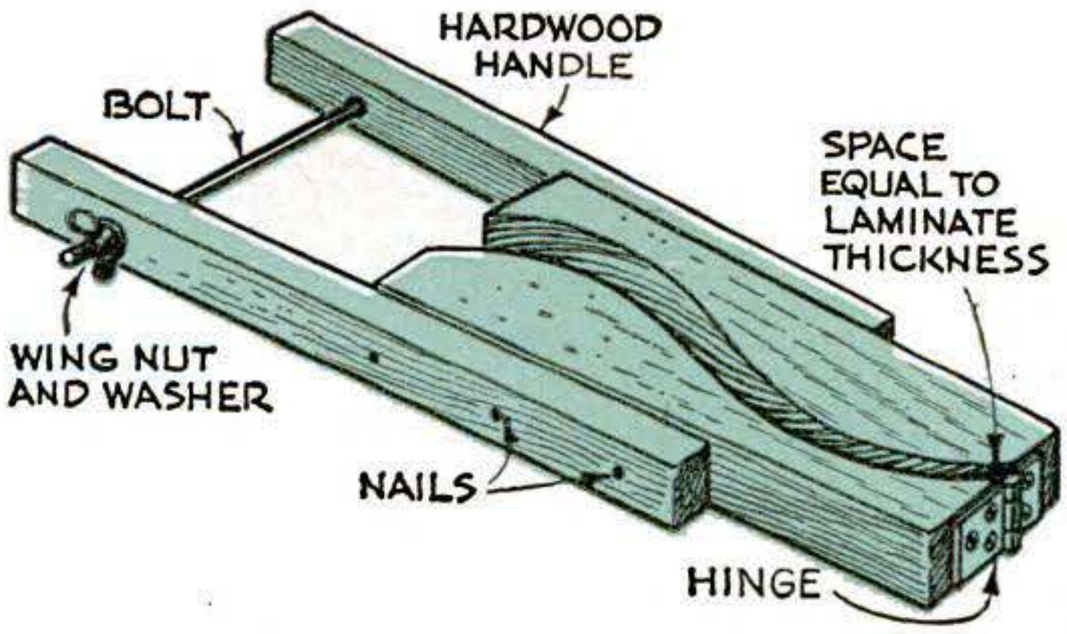
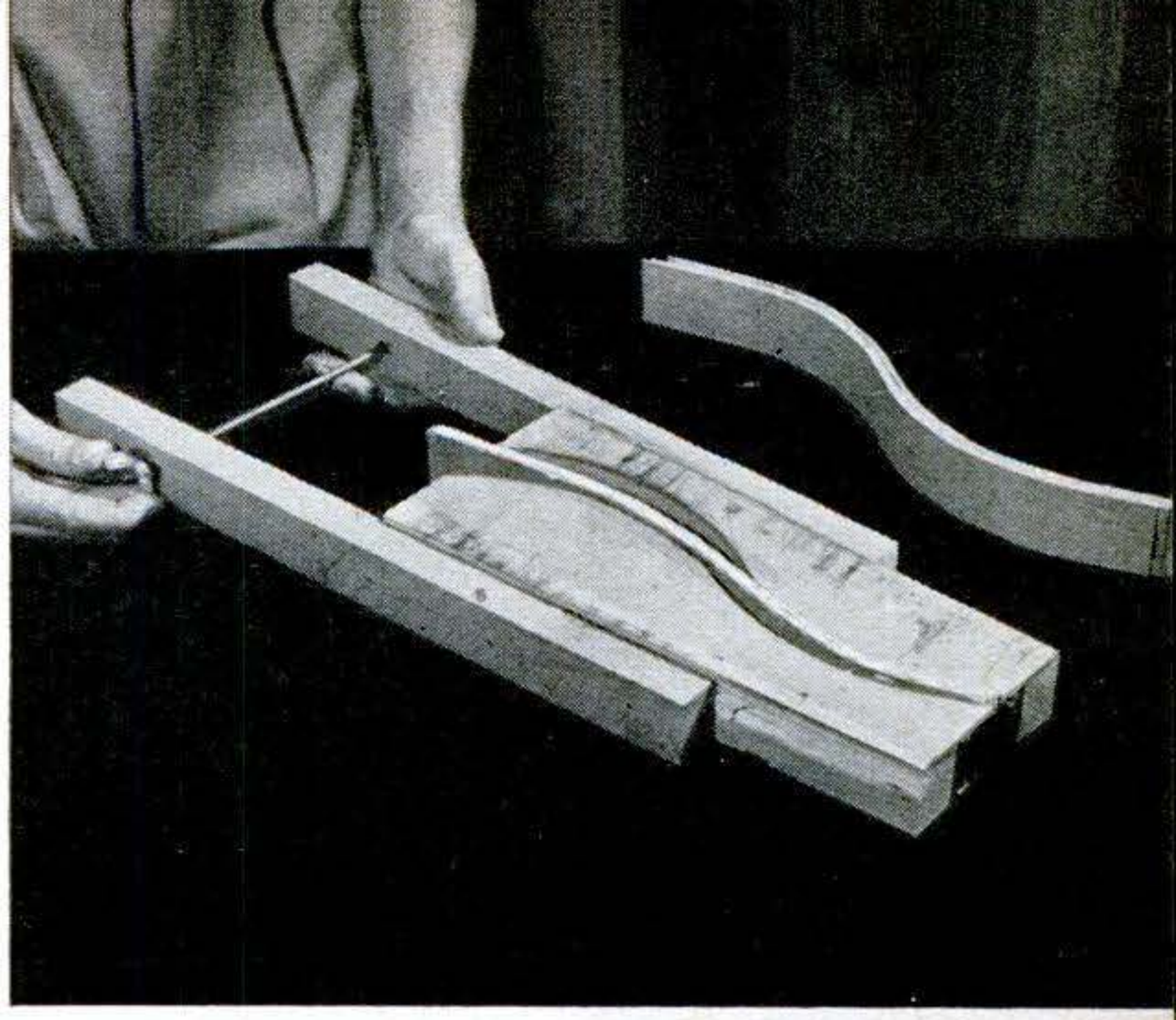
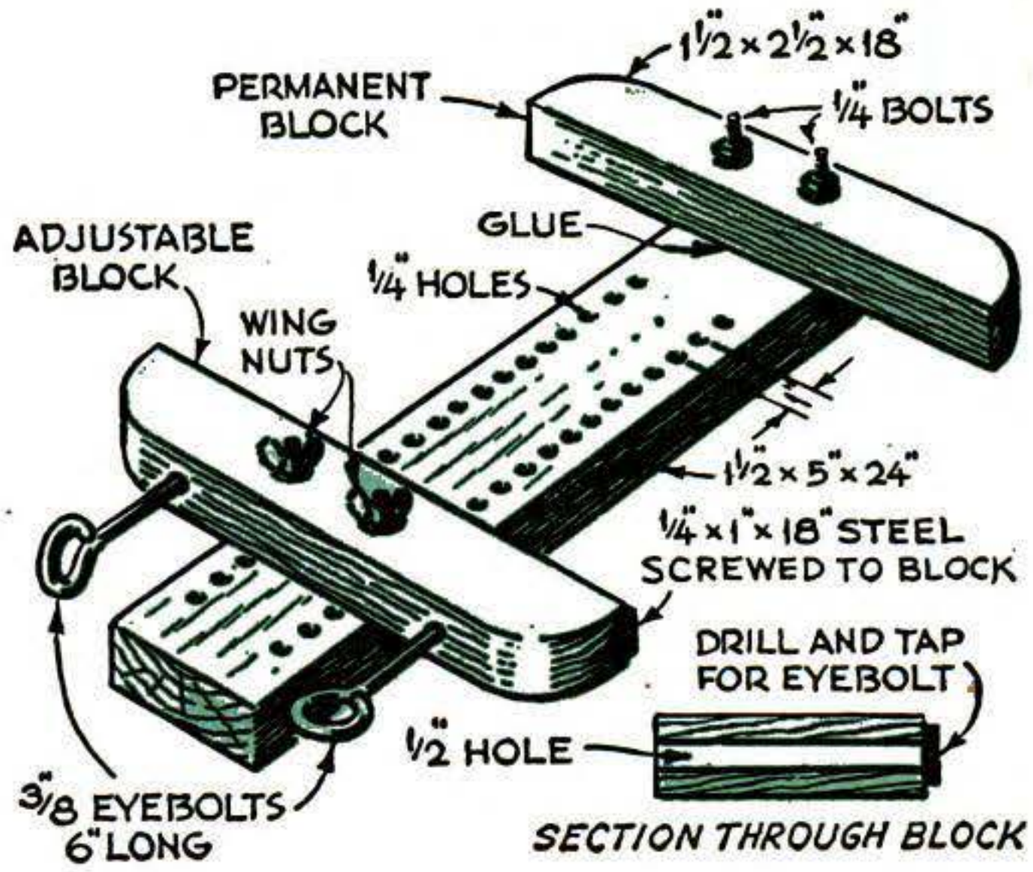
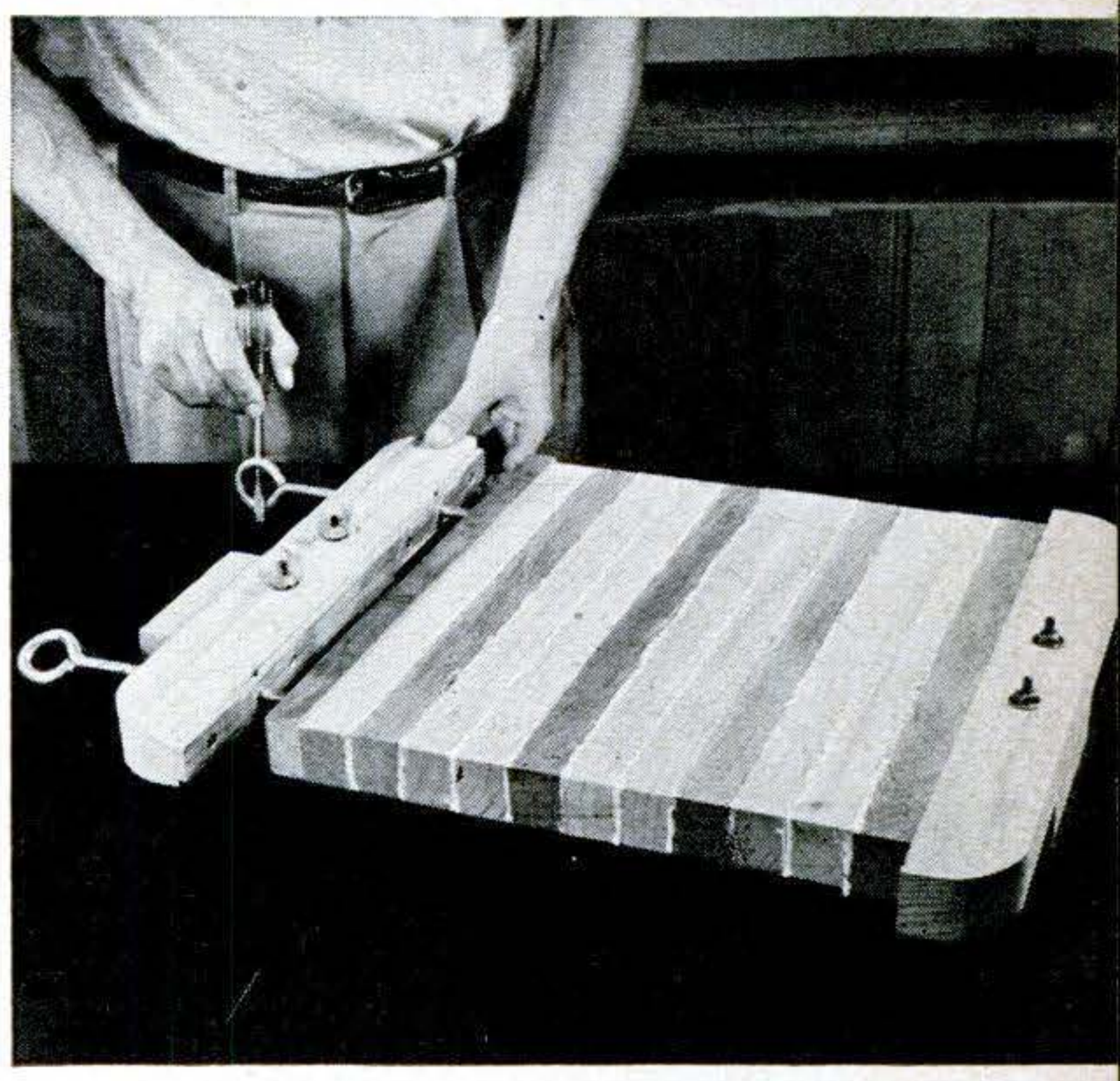


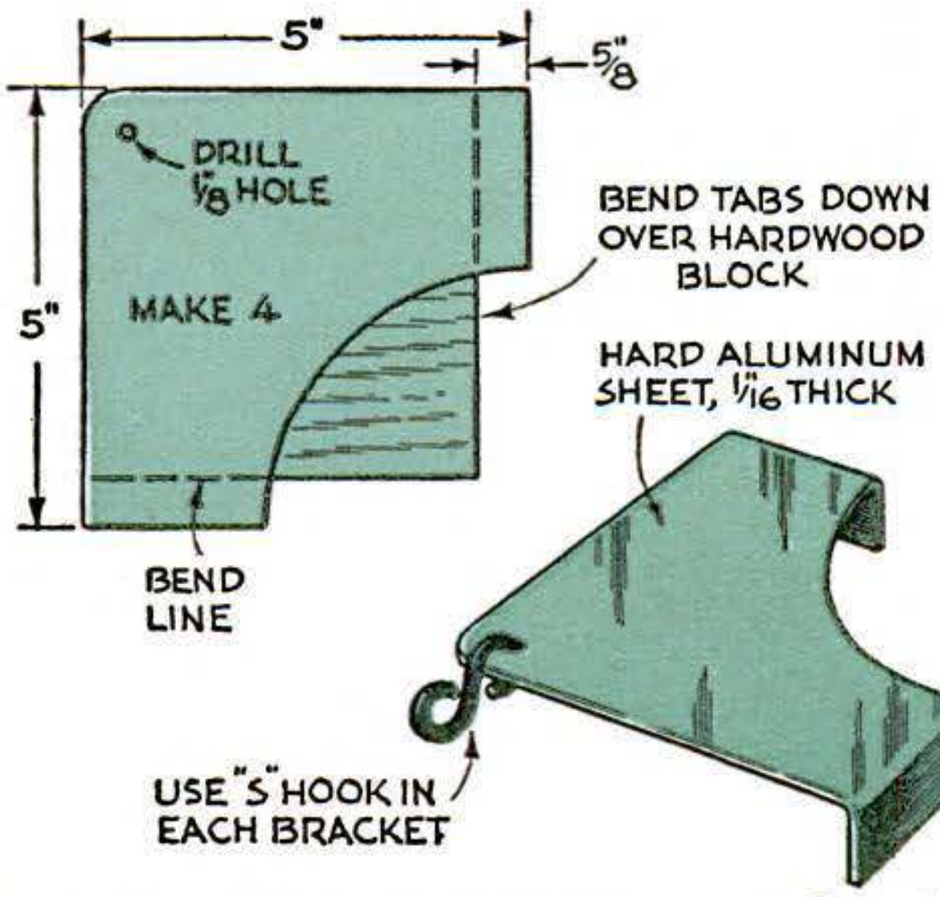


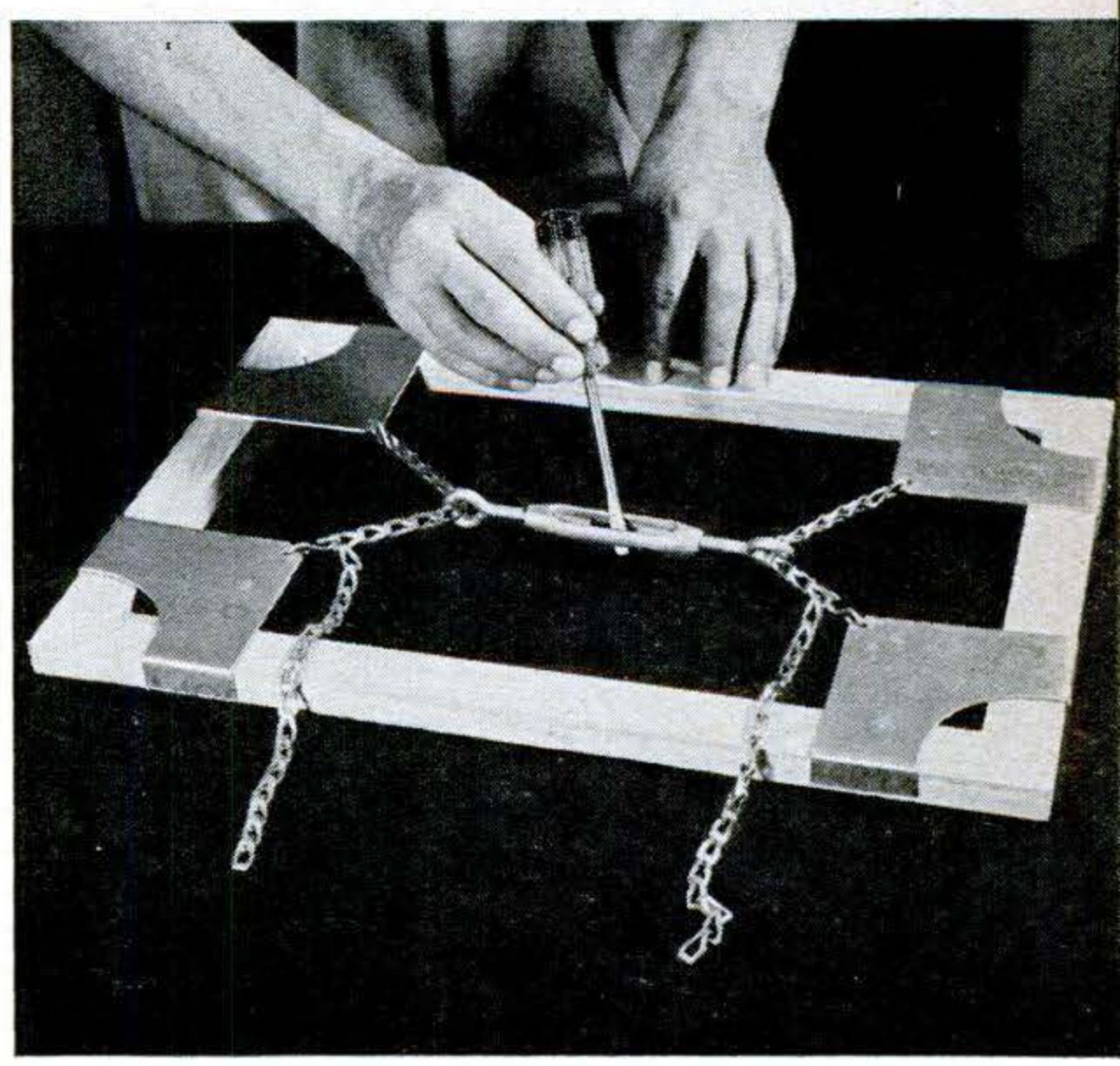
6 A SPECIAL PRESS enables you to make laminated curved wood parts by gluing together thin pieces. In bandsawing the forms (one cut makes both male and female), cut the curves deep enough to allow for spring-back—wood's tendency to return to its original shape.





7 EDGE-TO-EDGE GLUING for projects like a cutting board can be done effectively with an easily made glue press. Use a scrap block between the ends of the bolts and the wood being glued. Use waxed paper under the glued pieces to keep them from sticking to press.





8 ASSEMBLING A PICTURE FRAME can be a frustrating experience. But not if you use this handy rig—four metal brackets, some chain and a turnbuckle. The brackets shown were made from hard aluminum sheet. The setup can be used for square or rectangular frames. END

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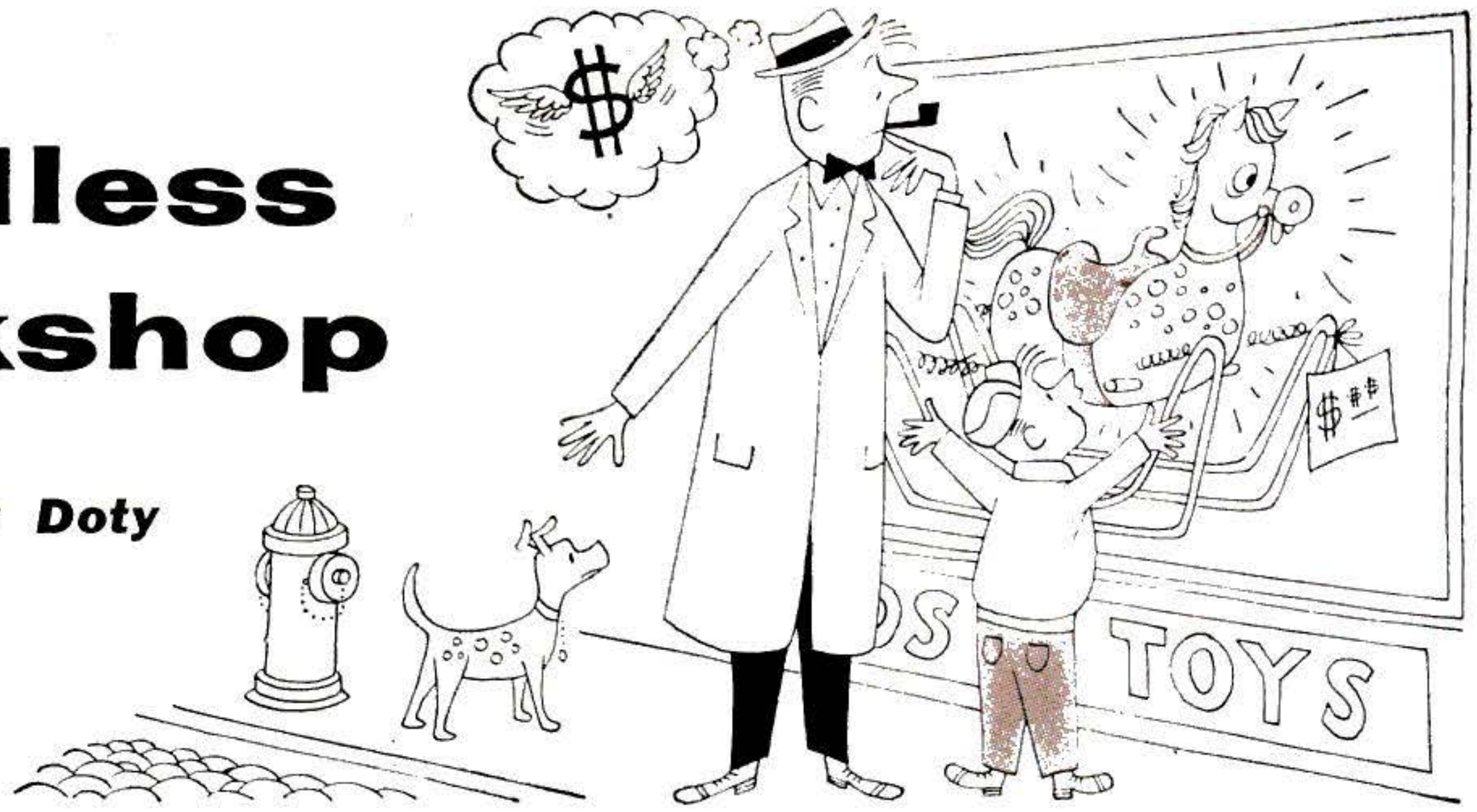
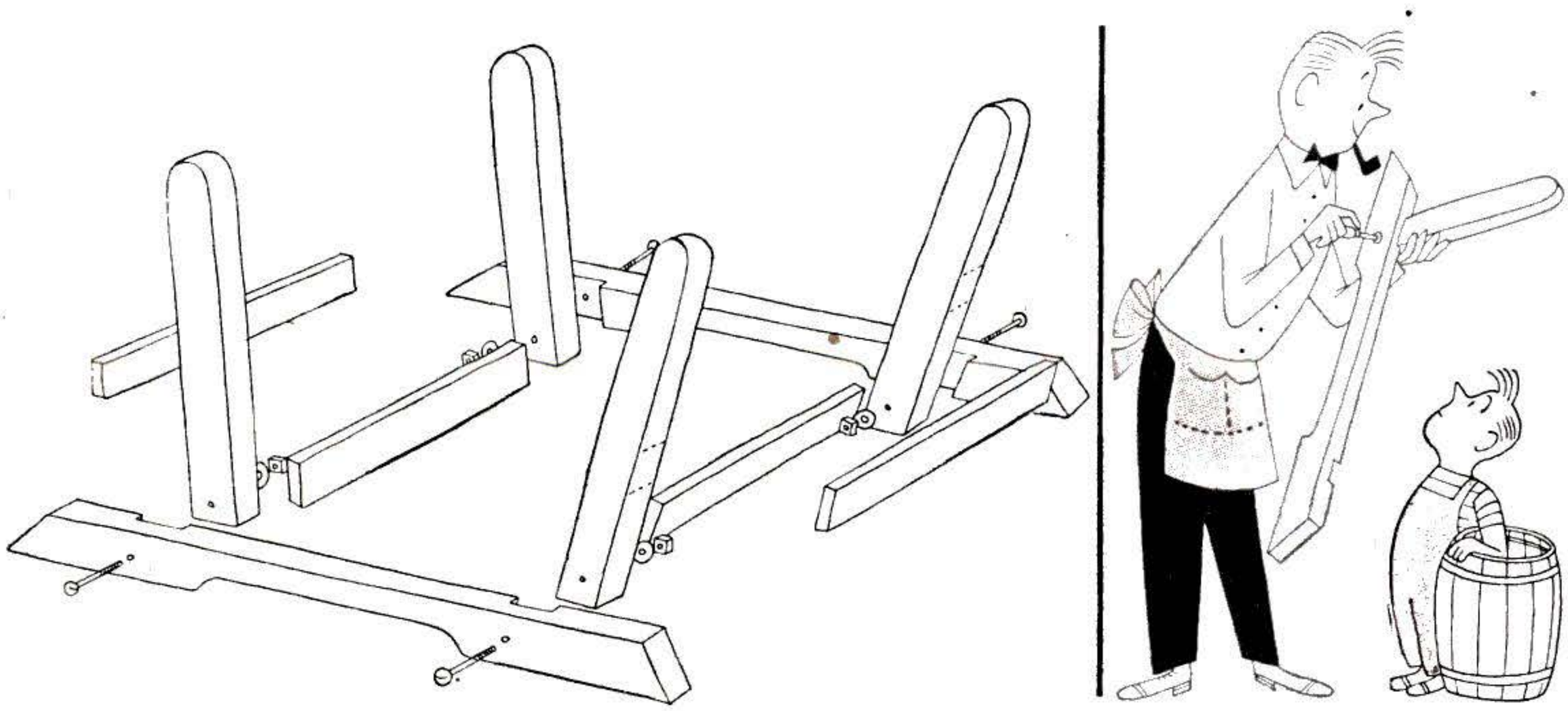
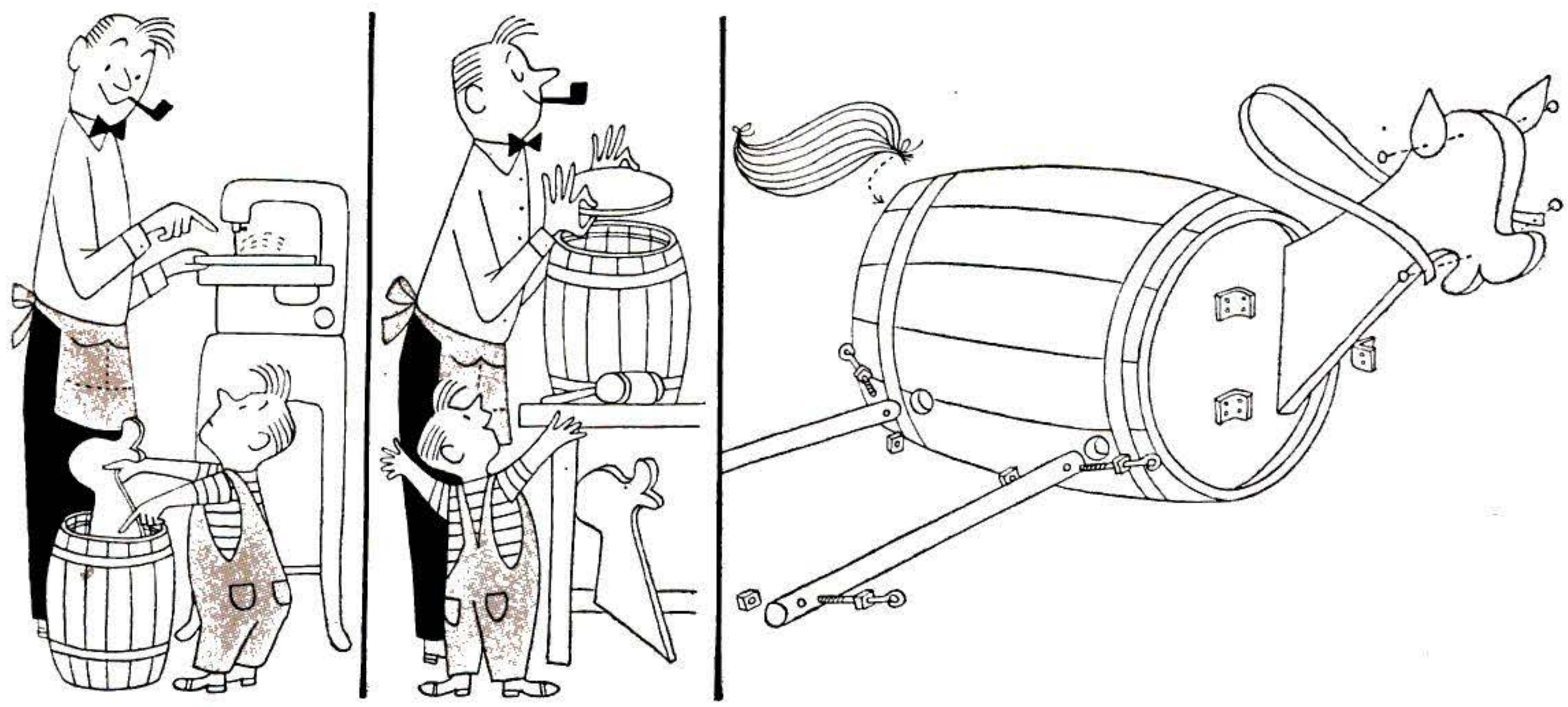
Wordless Workshop

By Roy Doty







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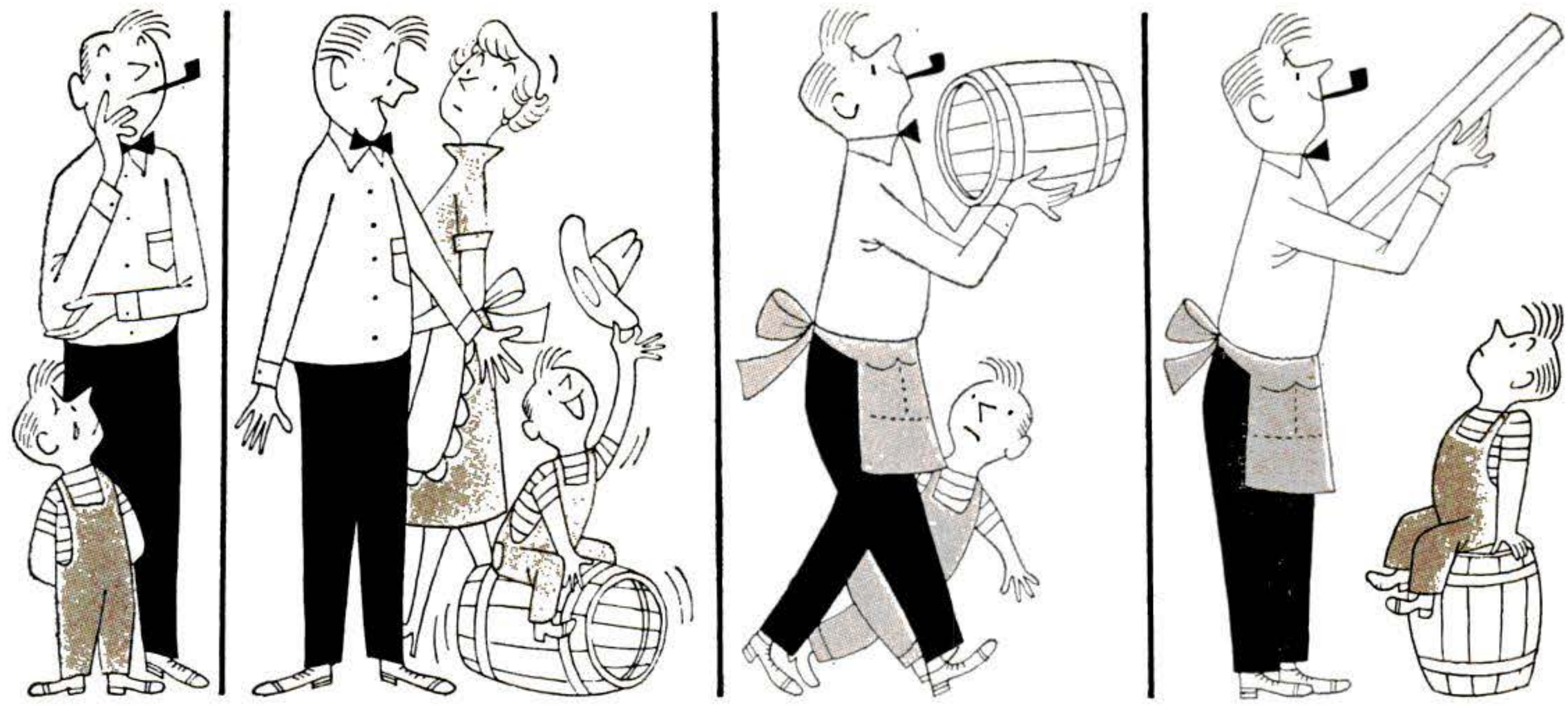

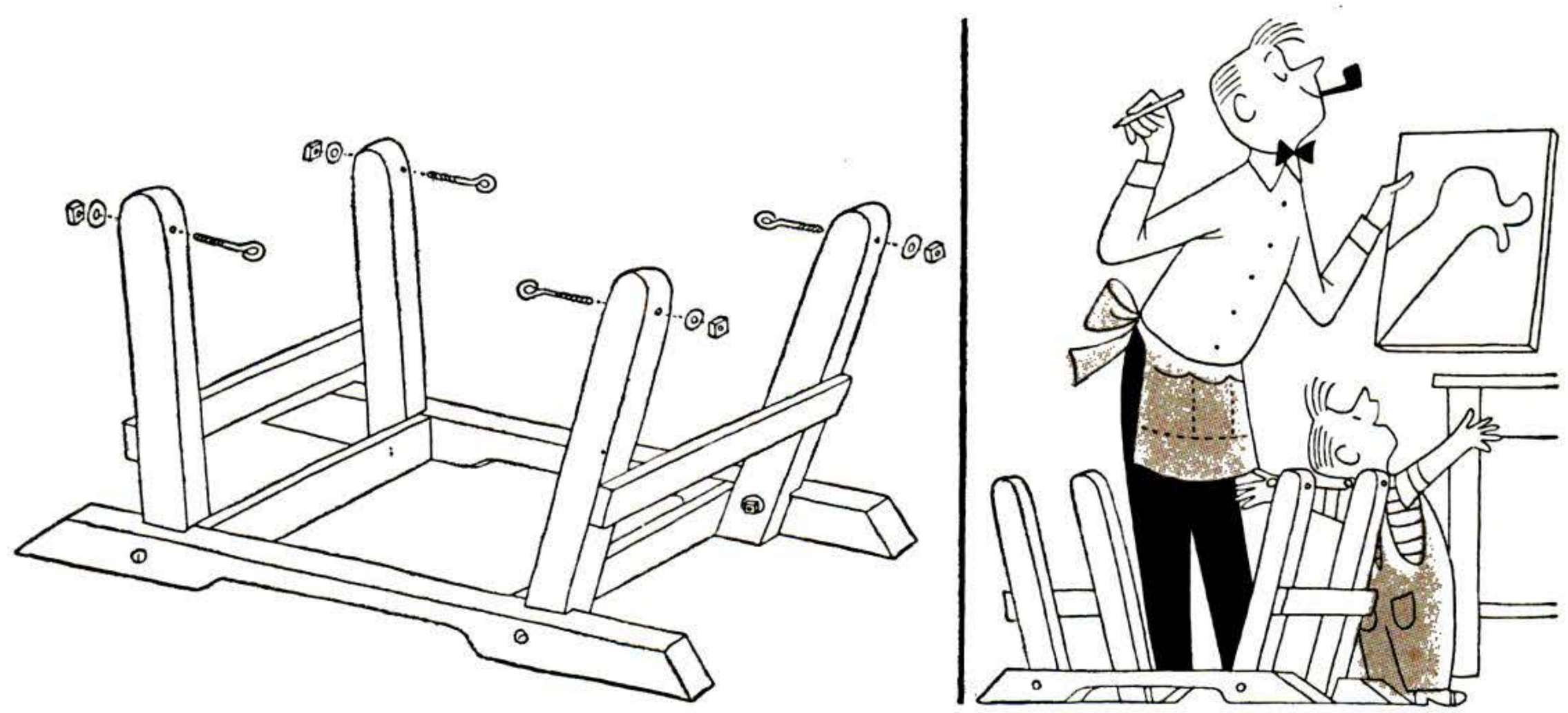

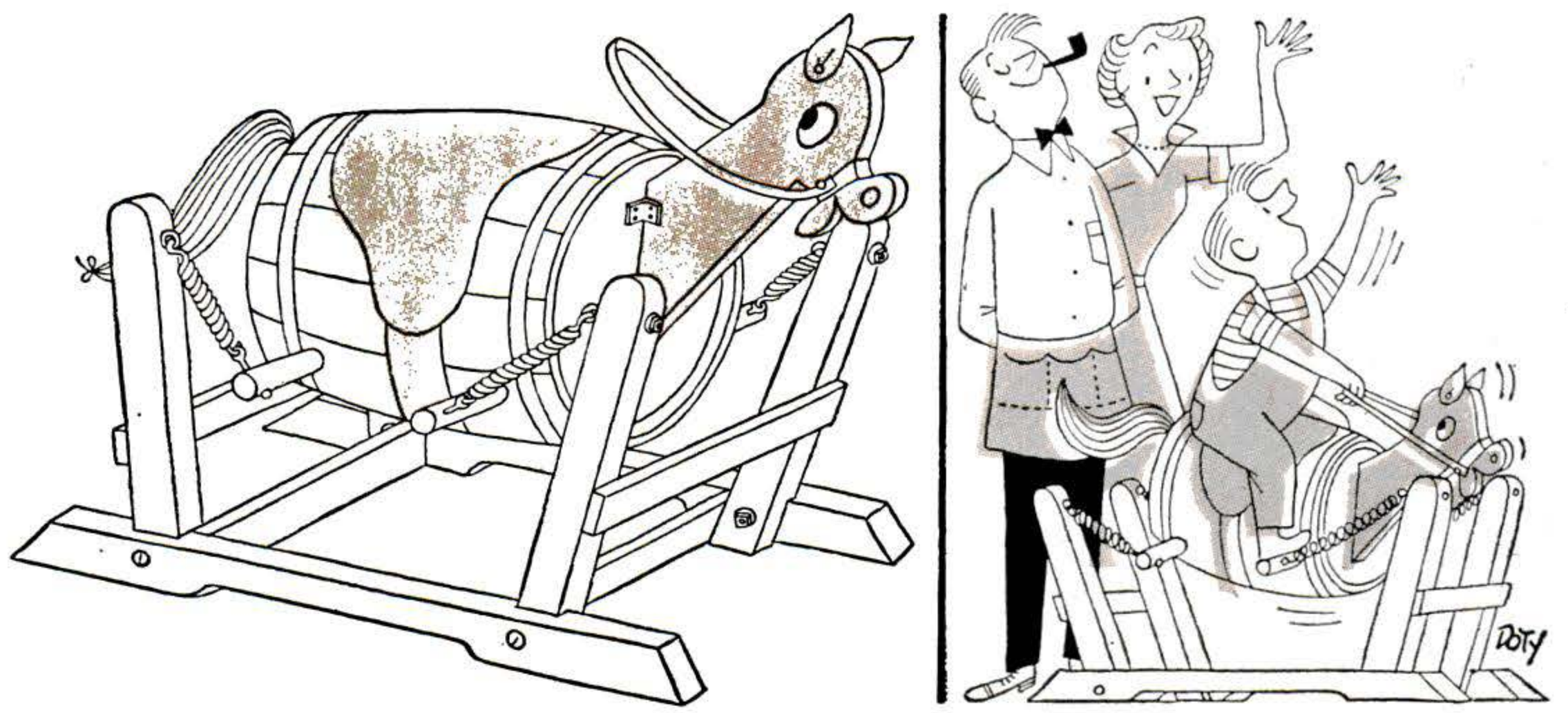

Next Month: A removable window perch for cat-napping cats

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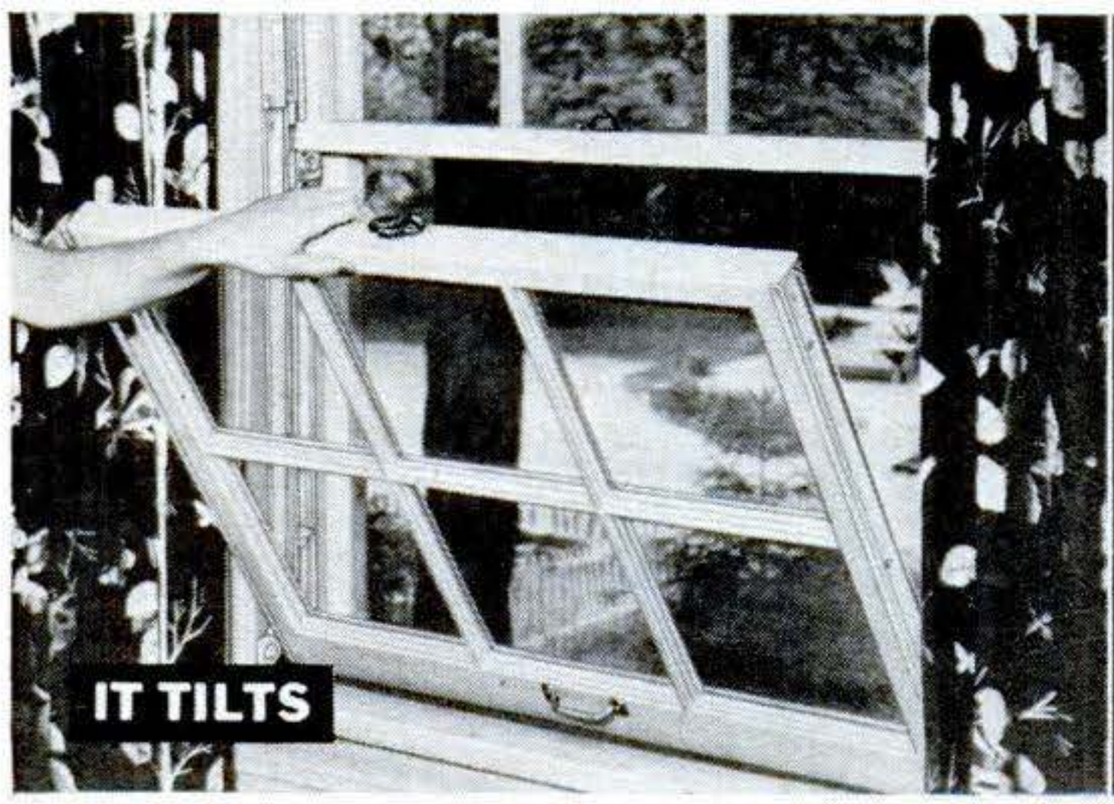
New Tilt-Slide Sash Makes Washing an Inside Job

HERE is a double-hung window with sashes that not only slide up and down but tilt inward at any angle like a hopper.

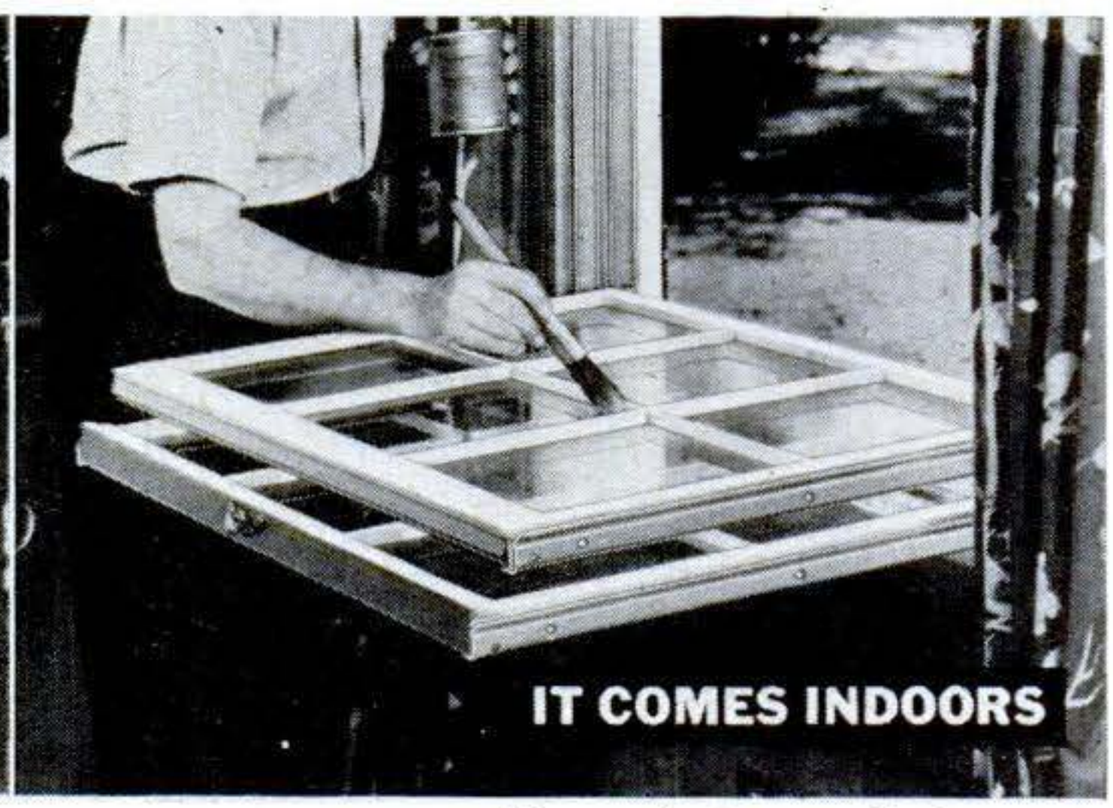
For jobs such as washing or repainting, you can do "outside" work while still in the house. Stops on the outer sash are so positioned that it will lie flat above its mate without touching. Either of the two sashes can be tilted open for ventilation at any point on the runners.

The new window, called Twin Tilt by its maker, Brown-Graves Co., Akron, Ohio, comes permanently assembled in its frame, with all hardware in place including two spiral balances for each sash. Available at lumber dealers in a variety of single- and multiple-pane styles, it costs from $26 to $45 a unit. There are standard sizes for new construction or old houses being remodeled.

LIKE A DOUBLE-HUNG WINDOW, sashes slide up or down in ordinary use. Instead of weights, cords and pulleys, they lift on built-in spiral balances with adjustable tension.



IT'S A HOPPER WINDOW, hinged at the bottom of each sash. Either or both sashes may be tilted in at any angle for no-draft ventilation.



FOR OUTSIDE JOBS like painting and cleaning, each sash can be tilted all the way in, and you don't have to remove storm sash or screens.

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Zero weather? Your car will leap into life with this unit that shoots—

More Sparks for Cold Starts

SUPPOSE, as your car starter grinds on a frigid morning, you could press a button that would multiply the single spark at each plug into many. You'd have not just one chance, but several, of firing the gas-air mixture each time a piston compresses it.

Instead of cranking many turns, the starter might get action with a dozen. You'd be rolling before the battery runs down. With a weak battery, those multiple sparks might make the difference between starting and not starting.

A flock of sparks is what a home-made spark expander provides in my 1947 sedan. With it, my engine has never failed to start on the first try—not even after five days in a snowdrift.

The main part of the expander is a vibrator like that in a car radio. While

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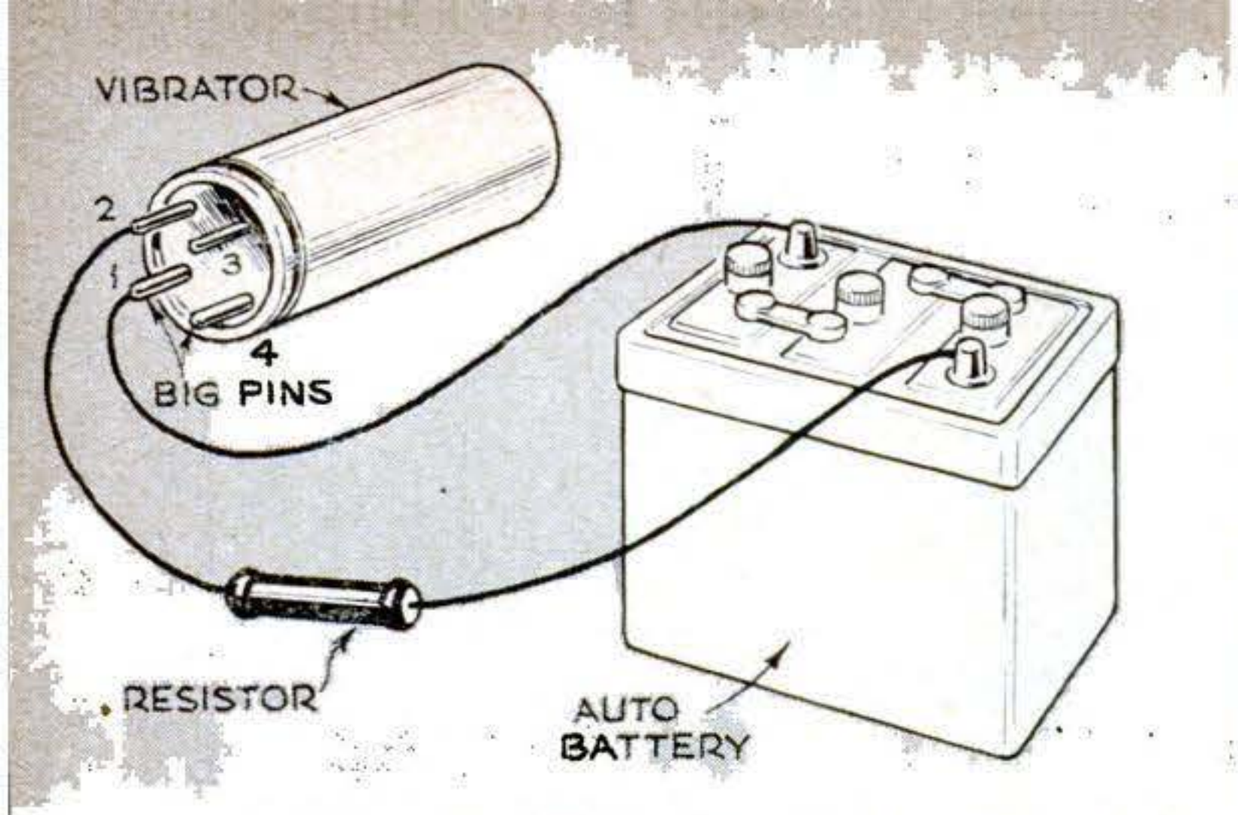
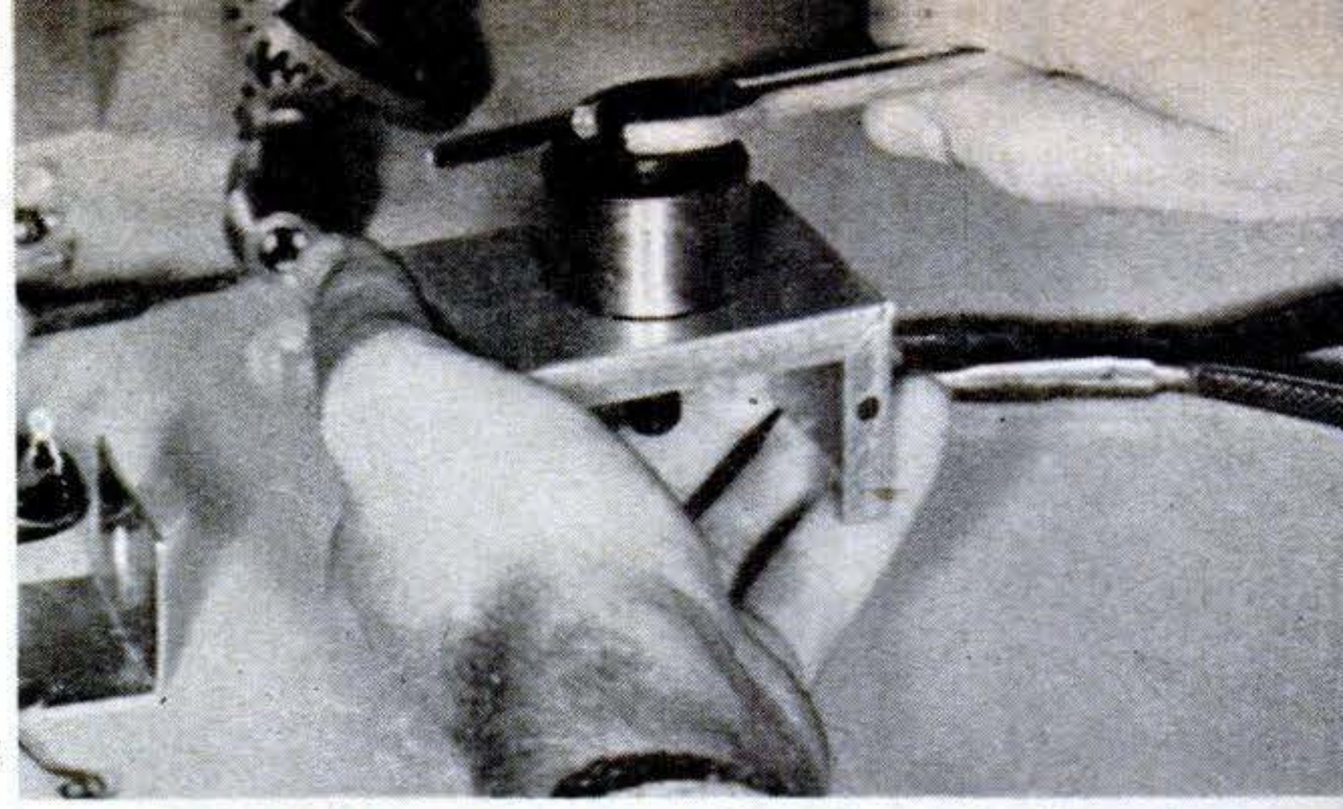
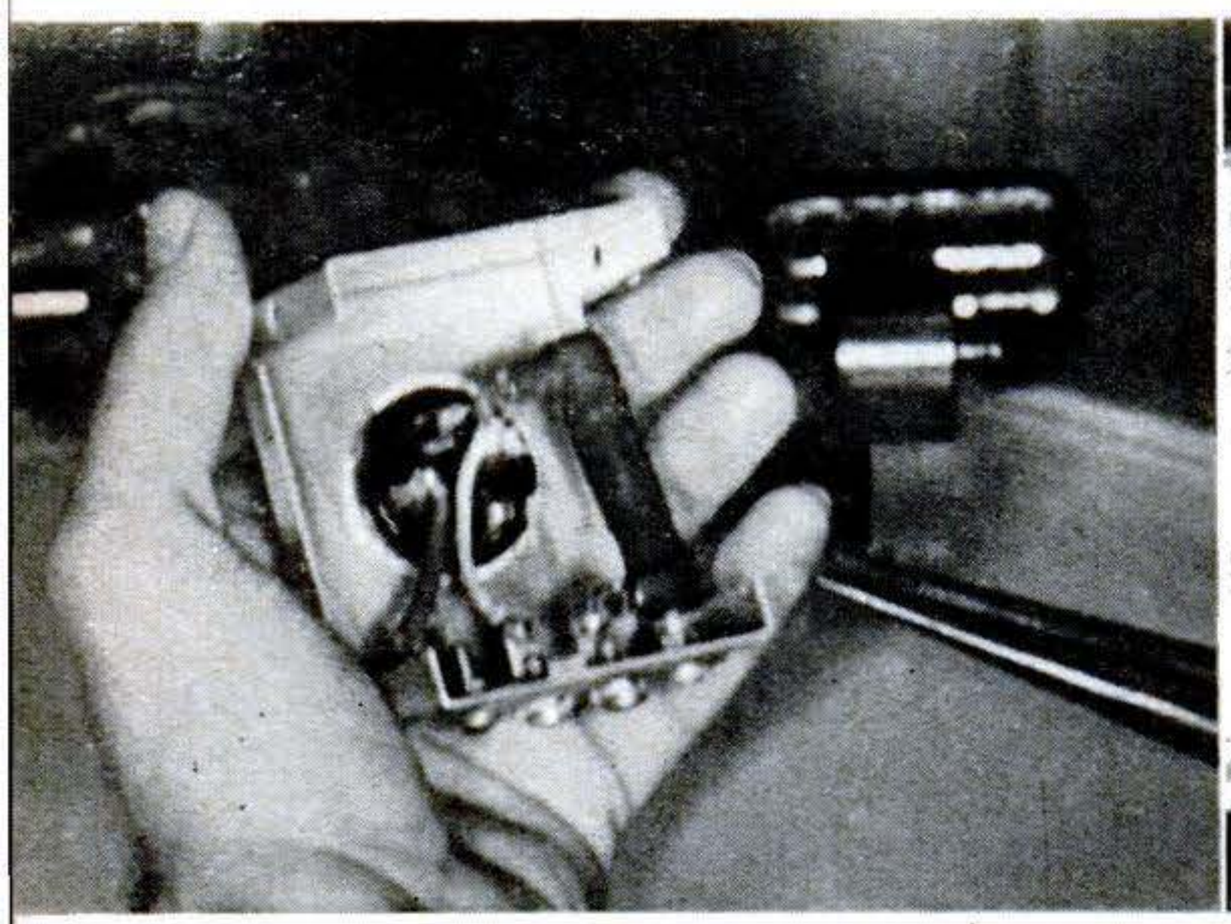


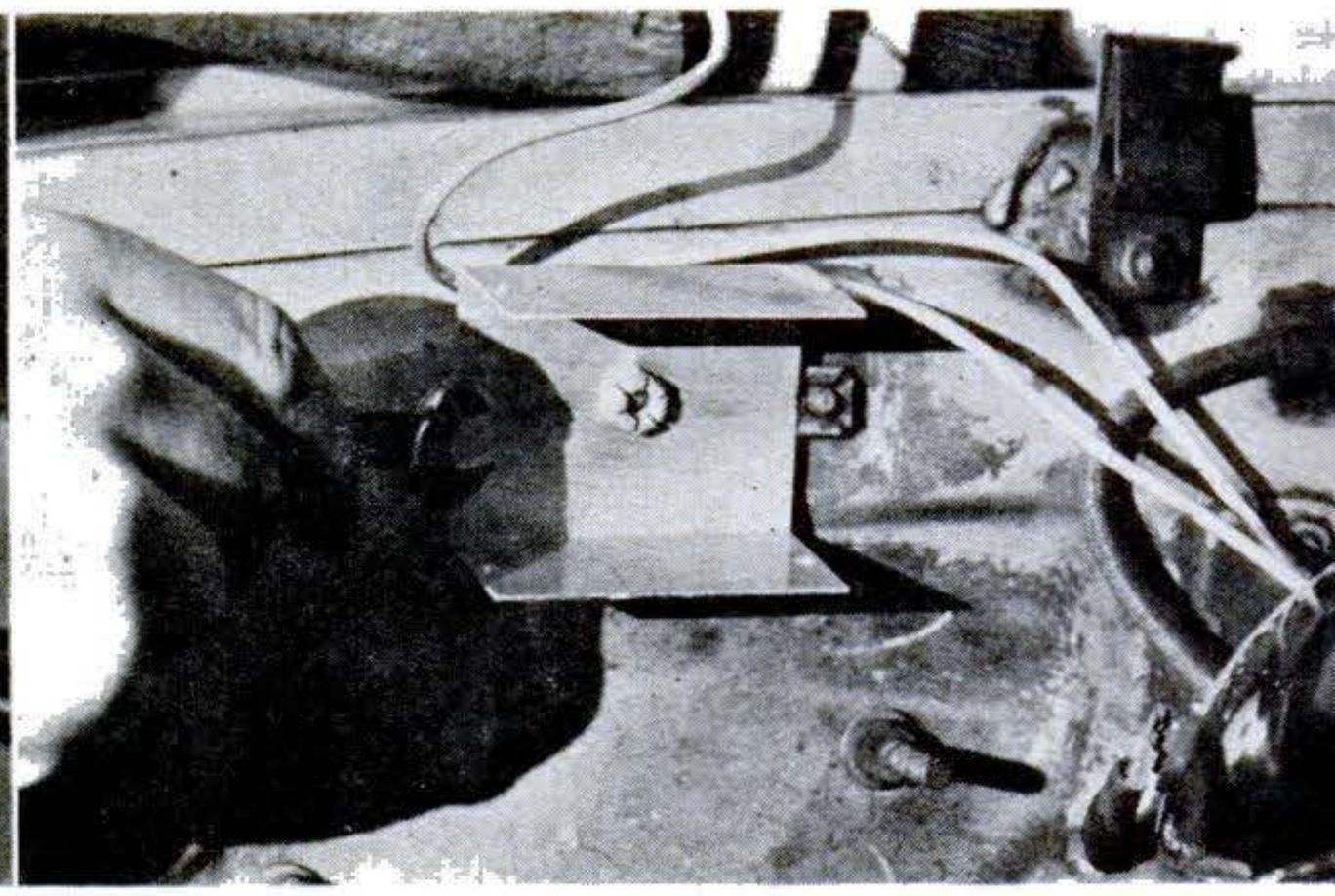
1. CHECK VIBRATOR FIRST to identify coil terminals. Connect pin 1 to car battery. With five- or 10-ohm resistor in other lead, touch pin 2, then 3. Note which pin makes vibrator buzz.



2. MAKE A 1" HOLE on top of ready-made chassis that forms case of unit. Use a chassis punch as shown, or drill circle of holes and file between. Mount a four-prong socket in the hole.



5. HOW CHASSIS LOOKS when wired. Prong 4 is not connected. Use only rosin-core solder, not the acid-flux type. Next, solder four long wires to the switch before installing it.



6. MOUNT CHASSIS BOTTOM on clean, bare metal to make good ground contact. Here it's held on a heater bolt by a second nut. Chassis is then attached with self-tapping screws.

the distributor points are breaking open once (sluggishly, since the cam is turning slowly) the vibrator makes and breaks the spark-coil circuit many times, generating a continuous spark until the points close again. The action is like that of the buzzer ignition in the old Model T Ford—but superior because the modern parts are better.

Since it does not boost voltage, this spark expander cannot harm the regular points, coil or condenser. It actually takes over the work of the points during starting. The coil and condenser do only their regular jobs, though more rapidly (as if the engine were running at high speed) for a brief period. As soon as the motor catches, the spark expander drops out of the circuit and has no further effect on ignition.

You can build it for about five dollars and in less than an evening. The wiring is simple, and all parts can be bought at any radio-supply house. Get a six-volt vibrator and five-ohm resistor if your car has a six-volt system, 12-volt vibrator and 10-ohm resistor for a 12-volt car.

To install the unit you mount the case somewhere under the hood and place a switch on or under the dash. There are only four wires to hook up. You do not change any existing wiring.

The unit can be left in the year round, or the vibrator can be pulled from its socket and kept in the glove compartment during mild weather. It may come in handy even then if the battery happens to be weak.

Two simple checks show you how to connect the vibrator and where to hook

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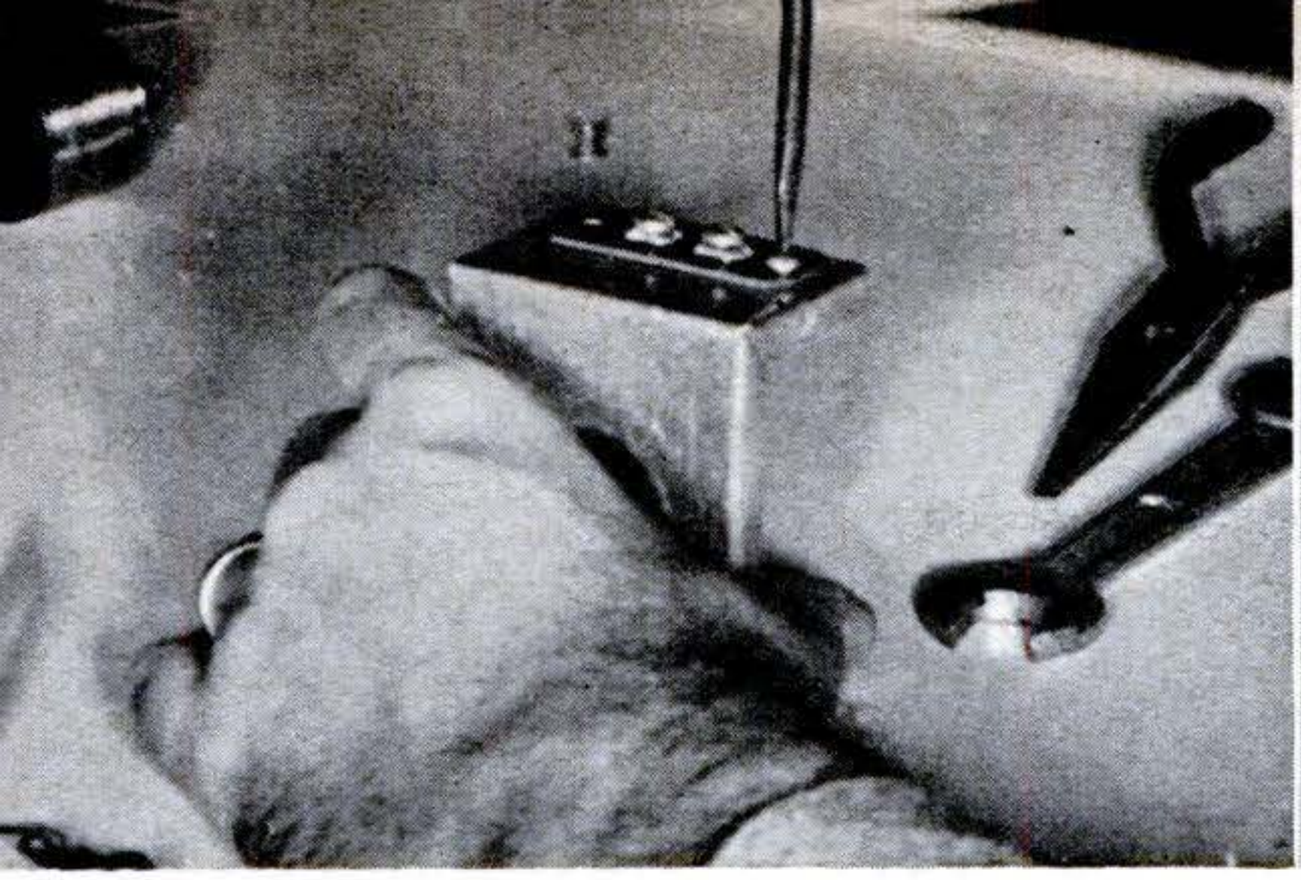
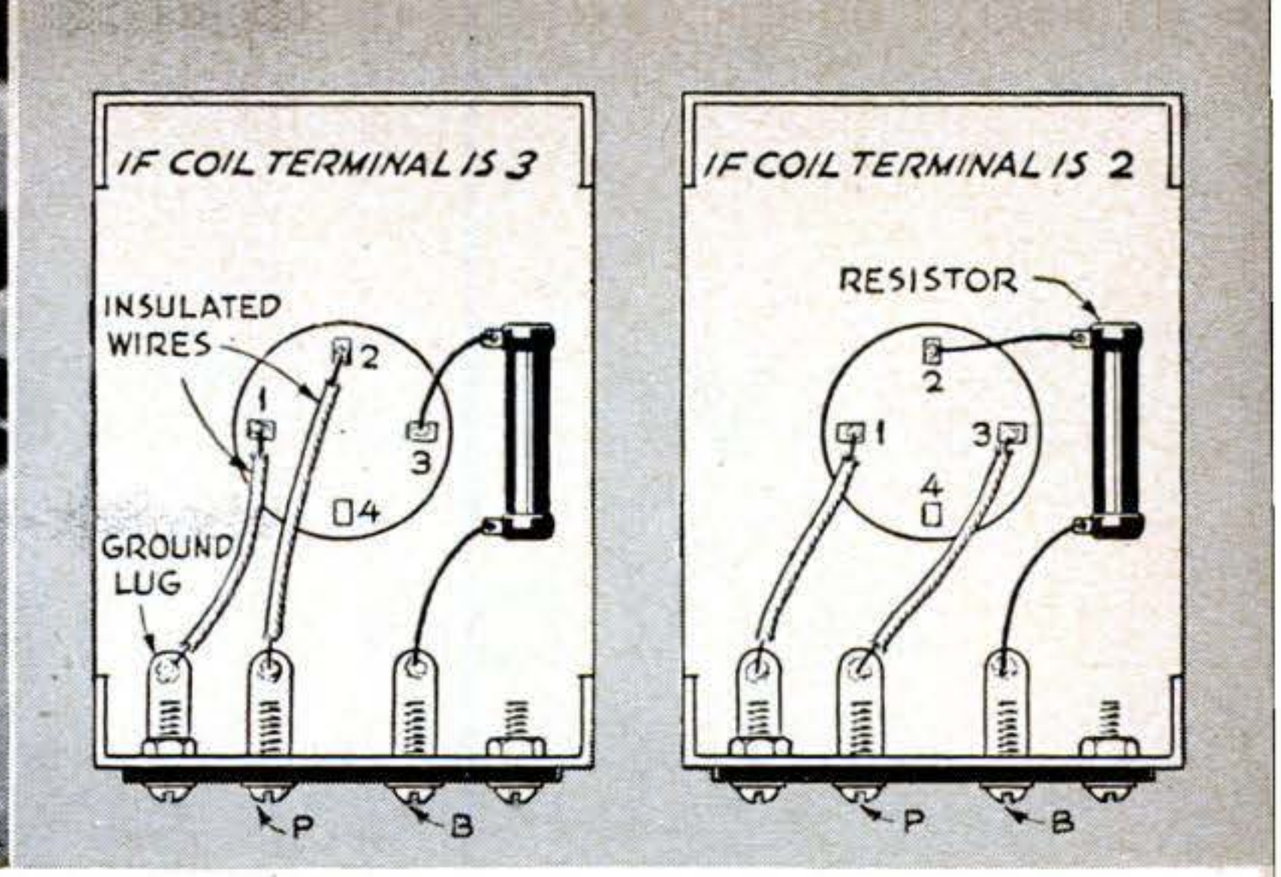
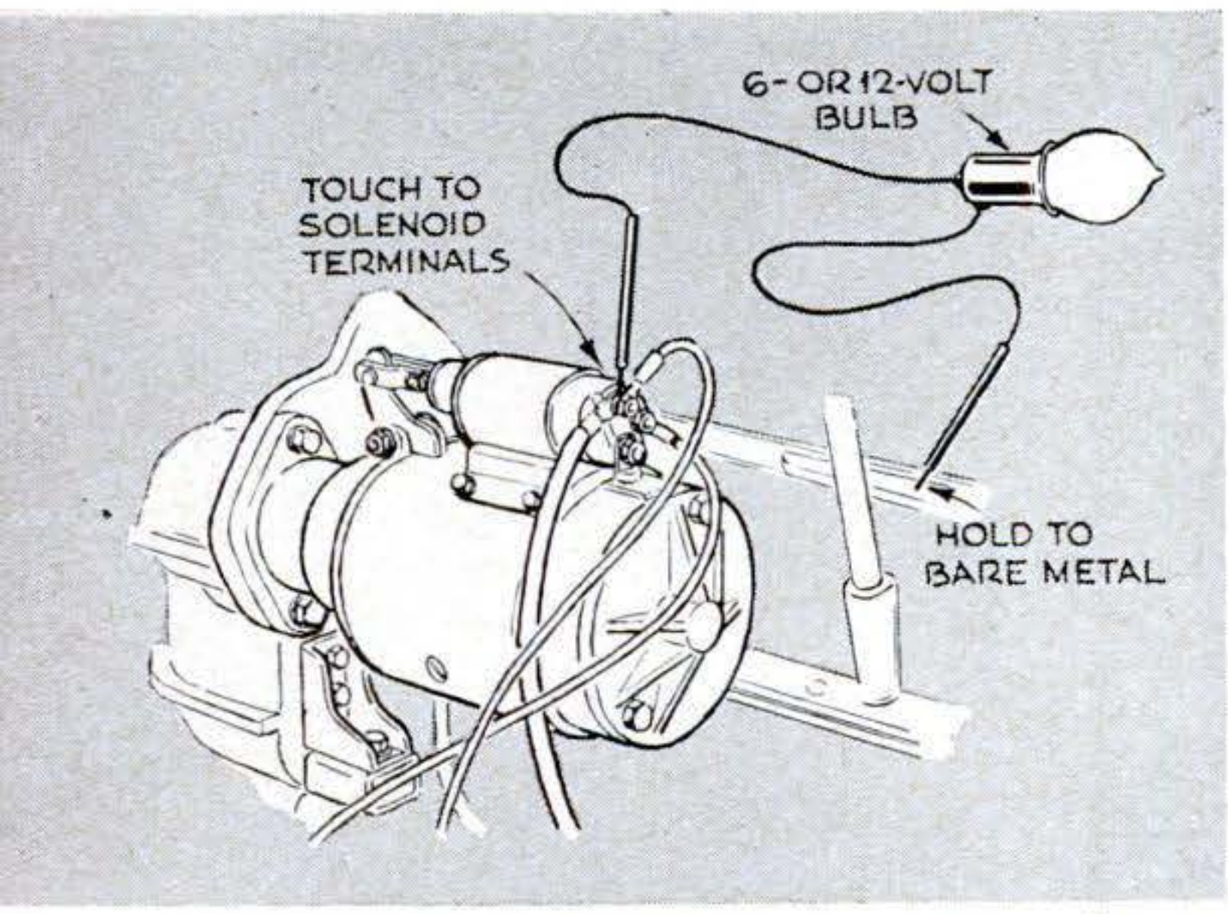


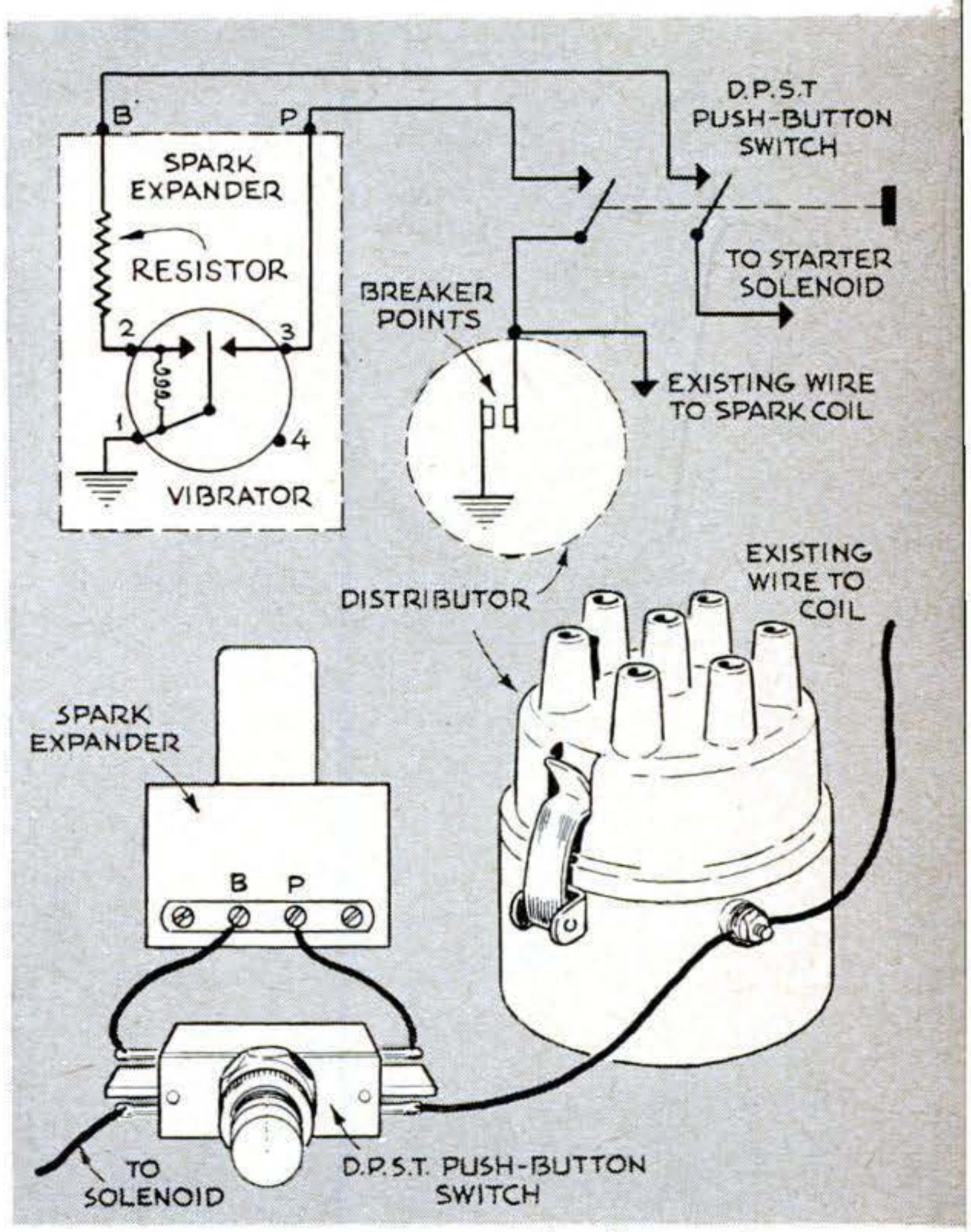
3. DRILL AND FILE a slot in one side of the chassis to clear the terminals on a two-terminal strip. Spot mounting holes, drill them, and fasten the strip in place with bolts and nuts.



4. WIRE PRONG 1 to a lug under a mounting nut. Solder resistor from a terminal (mark it B) to prong 2 or 3 (whichever is second coil terminal). Wire the other of these prongs to P.



7. FIND PROPER TERMINAL on starter relay or solenoid with two wires attached to a bulb. The terminal you want will make the bulb light when starter is turning, but not otherwise.



8. MOUNT THE SWITCH on a bracket or in a hole in the dash. Run wire from P to same side of switch as wire from distributor. Connect wire from B to side hooked to solenoid lead.

the expander into the starter circuit. For one you need only the parts that will go into the unit. To find the proper terminal on the starter relay or solenoid, you can borrow a bulb from the dash or dome light, or use a doorbell or buzzer. Check with it as shown in the drawing above.

On cars that have no solenoid switch, the lead that would otherwise go there can be connected to any hot terminal through a 10-ampere fuse.

To start up fast press the spark-expander switch while the engine is being cranked. Let go when it catches. On solenoid-equipped cars, the vibrator stops as soon as the starter does. The switch is needed to open the distributor lead to the vibrator, which might otherwise cause misfiring from road shocks. *—Julian M. Sienkiewicz, Brooklyn, N.Y.*

PARTS LIST

Aluminum chassis (Flexi-Mount 29435)
Vibrator (Radiart 5307 for 6-volt, 5503-12 for 12-volt system)
Four-prong socket (Amphenol 49RSS4)
Resistor (5-ohm, 10-watt wire-wound for 6-volt system; 10-ohm, 10-watt wire-wound for 12-volt system)
Two-terminal strip
Double-pole, single-throw push-button switch (Birnback 6235, Mallory 2004, or Switchcraft 1004)
Misc.: solder lug, 6-32 screws, nuts, lock washers, solder, insulated wire, bracket or other parts for mounting switch and chassis.

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How I Save $350 a Year on Car Costs

By Arthur C. West

SEVEN years ago, my neighbor, a garage foreman, practically put $2,495.50 in my pocket.

We were looking at a 1949 De Soto that I had just bought secondhand for $2,000. It had only 3,500 miles on the clock. Three months before, the car had sold new for $3,000.

"You saved a nice bit of change there," my neighbor remarked. "But do you know—that's just the beginning. You could save a couple of thousand more before you trade it in."

I was skeptical but interested.

"How? By setting up your own maintenance program," he continued. "And I don't mean doing just the oil and grease jobs at home. You have spare time. You could soon learn enough to handle 90 percent of your own repair work. Apart from the money you'd save directly, you could probably double your car's life by careful preventive maintenance. This buggy will go 100,000 miles. Why not use it all to spread depreciation thin?"

I took him up on the suggestion. Today I'm doing jobs that I never thought of doing before. A timing light is no longer a mystery to me. Neither are brake shoes and carburetors.

With the maintenance program that my neighbor helped me set up, I've saved an average of over $350 annually for the past seven years. A great part of this represents savings made through my own labor—at a time when professional labor is at an all-time high.

I'm still driving that '49 car and it's still far from a junkyard. Already it has given me around 80,500 miles of dependable transportation at the far-below-average cost of 5.8 cents a mile. As a member of the U. S. Border Patrol along the Mexican border, I work with cars that must take rough going. And my family car isn't pampered either. Yet this 5.8 cents includes everything—depreciation, servicing, repairs, insurance and license fees, and fuel. Today's average motorist, says a big accounting firm, spends 10.8 cents a mile.

But I don't figure my savings on that figure; costs were lower when I started doing my own maintenance in '49. Instead, I've taken the national auto-cost average of 1953 as a mean. This was 8.9 cents a mile, 3.1 cents more than my 5.8-cent cost. On this basis, my overall saving for 80,500 miles has been $2,495.50—the price of a new car.

What are the jobs I do? The accompanying tally of my expenditures over seven years indicates some of them. For instance, I repack front-wheel bearings and universal joints, adjust and replace ignition points, clean spark plugs and adjust brakes. When brake linings are worn, I pull off and replace the shoes. I keep an eye on radiator hoses, brake hoses and electrical connections.

If necessary, I can replace leaky hydraulic-brake cylinders with new ones, tell whether I need a new fuel pump (and install it), and handle minor body-repair and touchup jobs. I have also learned what not to do. For instance, I don't have wheels balanced unless there is evidence of tramp or shimmy, or have wheels aligned unless front tires show telltale scuff marks. I do my own wheel balancing, but leave aligning to a pro.

Good tools pay off. On the advice of my garage-foreman neighbor, I started my maintenance program by laying out

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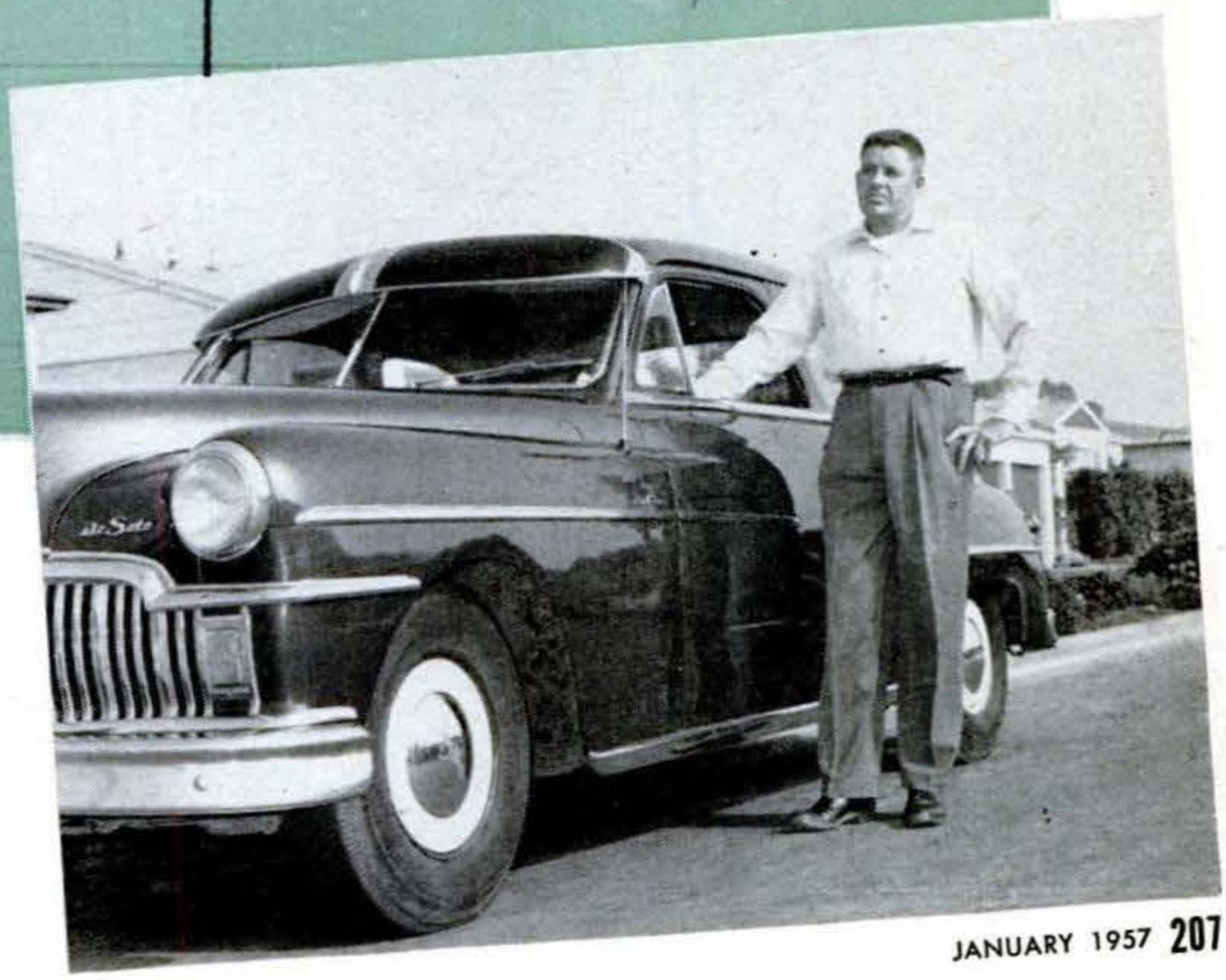
TALLY OF CAR COSTS FOR 7 YEARS

Lubricants and parts for repair jobs AT HOME		Garage repairs, and purchases involving GARAGE SERVICES	
Motor Oil	$78.00	Complete motor overhaul, including new rings, wrist pins, bearing inserts, timing chain and motor mounts. Valve job. Clutch and radiator repaired	$154.00
Oil-filter cartridges	21.00		
Grease, other lubes	18.00		
3 brake-wheel cylinders	11.20		
2 brake hoses	3.80	Wheel alignments and balance jobs	39.00
Set of brake shoes	6.48		
Voltage regulator	8.38	Valve-grind @ 33,000 mi.	23.00
Fan belts, radiator hose	6.15	4 new 7.60×15 tires	88.00
Carburetor-repair kit	5.80	12 retreaded tires	144.00
3 sets of points and condensers	6.20	Battery (48-mos. guar.)	19.20
Misc. items under $2.	101.00	Nylon seat covers, paint job, and minor body-work repairs	75.00
	$266.01		$542.20



ARTHUR WEST and his family bus. A U.S. Border Patrolman on the Mexican border, West doesn't pamper an auto on the road—not even his own. Dust storms and heat add to his car-upkeep problems.

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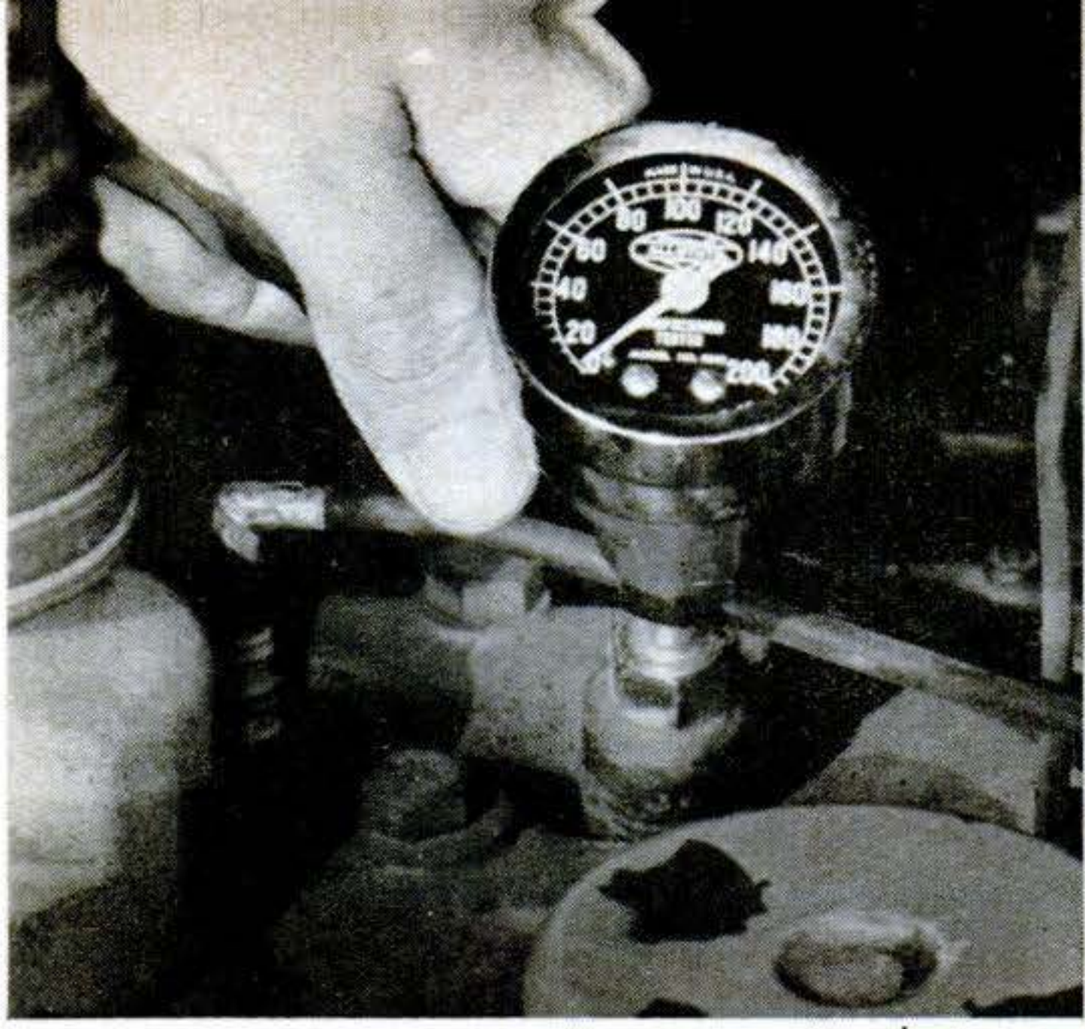

A COMPRESSION GAUGE spots little troubles before they become big ones. West checks with it every time he cleans plugs. A drop in compression may show need for valve or ring work.

FREE BREATHING is essential to good engine performance, but servicing the air cleaner is a chore most gas stations skip. It's easy to do yourself, as West does every 5,000 miles.

List of Auto-Repair Tools

Portable air compressor (piston type, with tank), secondhand	$125.00
Air-pressure-operated grease gun, 50′ air hose and quick connectors, blow gun and tire chuck	30.00
Hand pump for transmission and differential grease	2.50
Socket-wrench set (¼″ and ½″ drive), plus deep socket for spark plugs	37.00
3 crescent wrenches (4″, 8″, 12″)	6.50
Set of screwdrivers, including Phillips Nos. 2 and 4	4.50
Set of ignition tools, feeler gauge and spark-plug gauge	5.00
Timing light	4.00
Compression gauge	5.10
Brake-adjustment tool, and master-brake-cylinder fluid filler	2.00
Rear-wheel puller	7.50
Three-legged bumper jack, and two safety horses for rear axle	15.00
Trickle battery charger, hydrometer, filler bulb and distilled water	12.00
Auto-repair manual	6.00
Miscellaneous, not over	12.90
Total	$275.00

$275 for tools. My friend insisted that I buy topnotch tools, and at the time the price seemed pretty steep. But I paid for them in my first year's savings.

Checking my tool list, you'll note that the most expensive item was a portable air compressor—$125, secondhand. However, it's the most indispensable tool in my garage. I use it to pressure-lube the car, clean the interior, inflate the tires, touch up body paint, quick-dry newly cleaned parts, and tidy up my shop.

A manual is mighty handy. With the tools, I bought a good motor manual. At first, I didn't quite appreciate all of the useful information it contained. But I was careful to consult it each time I tackled a repair job. (It's important to buy one that's up to date.) Results were so successful that within six months I decided I was quite a mechanic. It took an incident to teach me that I wasn't.

The day before I was to start on a long trip, I made up my mind to take the carburetor apart and clean it out. There was no real need for this, but I wanted to prove that I could do it.

Overconfident, I forgot all about my manual, tossed the carburetor parts helter-skelter into a pan, cleaned them and started the reassembly. But I couldn't remember what went where.

After three hours I grew panicky. I put in a call to an auto parts-supply house. A new carburetor would cost me

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HOME LUBRICATION may not pay off, grease job for grease job, but attention to such details as cleaning fittings before applying the gun does yield dividends in long car life.

FOR BATTERY ECONOMY, West buys one with a long guarantee, checks water weekly, keeps it fully up with a home charger, and sees that the cable terminals are always clean and tight.

$40! My neighbor came home about this time and I smuggled him into my garage. He took one look and said: "Where's your manual?"

He flipped it open to an exploded drawing of the carburetor, laid out the parts in corresponding order, and had the thing back together in 30 minutes.

"Your manual is a big help," he remarked as he worked. "But don't rely on it 100 percent. When you take down anything with more than two parts, lay the stuff out in order. Index parts, if necessary, with dabs of paint or scribe marks. I've been meaning to tell you this, too: It's good to keep a file of maintenance tips you find in magazines."

Lubrication is inexpensive. I don't go for the idea that a 1,000-mile oil change is mandatory. I only change the oil and oil-filter cartridge every 5,000 miles, except when I run into a dust storm. Then I change right away.

I use the best motor oil I can buy, and get it by the case. I could save more by buying it in bulk, but the quart cans are convenient. Each time I change the oil and cartridge I clean the carburetor breather and the oil-breather cap. My car went 65,000 miles before it needed a ring job.

For general lubrication, I now use the new, all-purpose grease. A 35-pound pail cost me about $6, and will last the life of my car. I shoot it into all chassis lube fittings, wheel bearings, universal joints, water pump and other fittings every 1,000 miles. The only other lubricants necessary are rear-end grease, transmission oil, a can of fine machine oil, and a lube stick for the door and hood catches.

Other maintenance chores have become routine, too. The lesson I learned when I disassembled my carburetor was a good one. My manual has made most light repair work fairly easy.

I use a compression gauge each time I remove the spark plugs for checking and cleaning. Any sudden drop indicates valve or ring trouble.

But when I run into major mechanical work, I "let George (a dependable garage mechanic) do it."

Overinflating my tires somewhat has contributed a large part to my maintenance savings. I also check them weekly, and rotate them every 5,000 miles. My car's original set wore smooth at 13,000 miles when I ran them at the recommended 24 pounds. I replaced them with a set of first-line tires and increased the pressure to 30 pounds.

When this set wore smooth, I had

NEXT MONTH . . .

Would YOU dunk a typewriter in water to clean it? Some pros do. An article in the February issue will tell you how to do such cleaning at home.

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them retreaded—not recapped—and I have been using retreads ever since. Retreading the original set gave me another 20,700 miles of life. The next set of retreads, which I drove 4,000 miles over dirt and gravel roads, didn't do so well —only 17,500 miles. I buy retreads only from a reputable outfit, and always look them over to make sure the carcasses are fresh and not weather-checked.

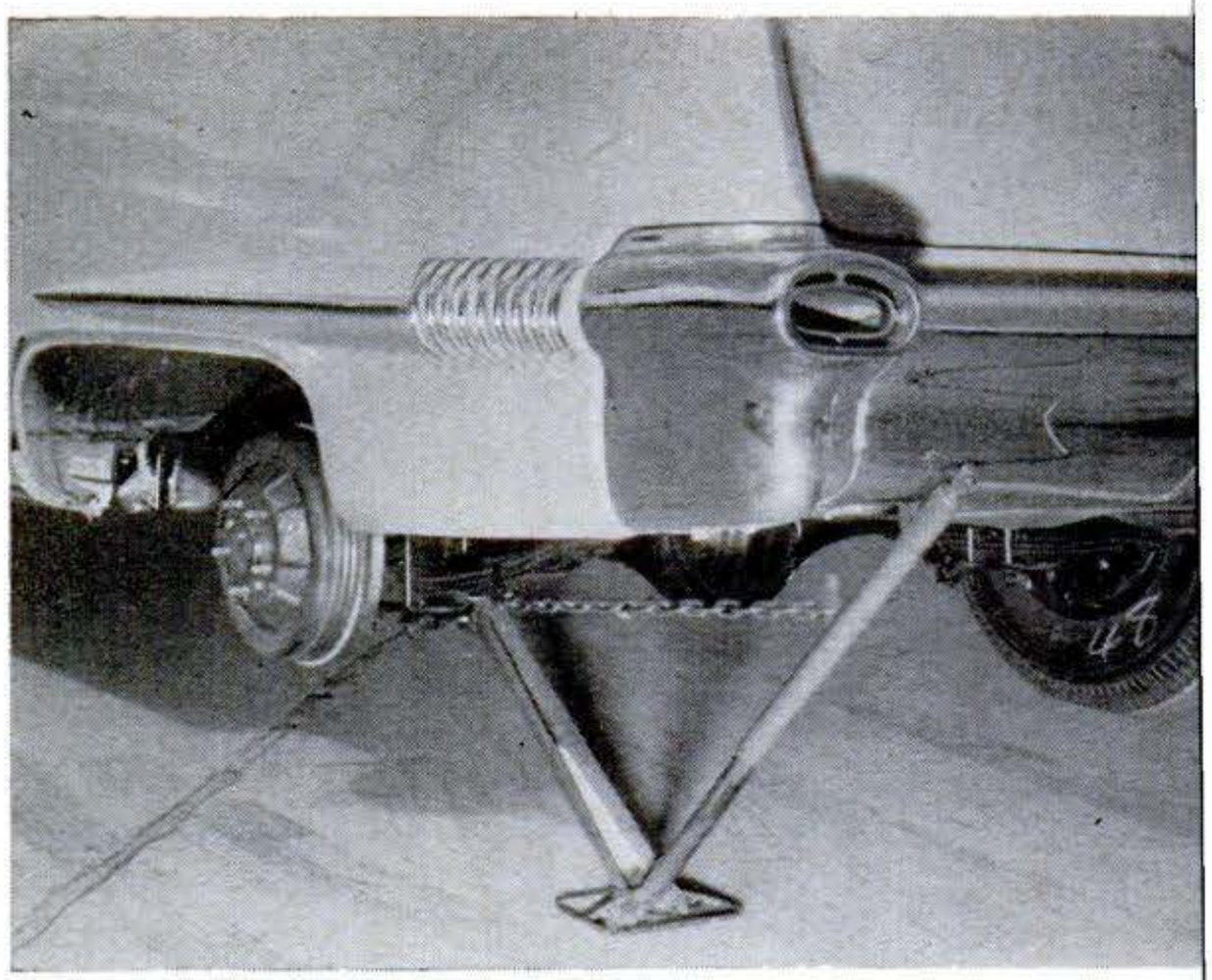
That 5.8-cents-a-mile average breaks down like this: Figuring that my car will have no resale value by the time it has run 100,000 miles, depreciation over seven years has been about $1,500, which comes to $214.28 per year. (Actually, the car will still have at least junk value —and more on a trade-in.)

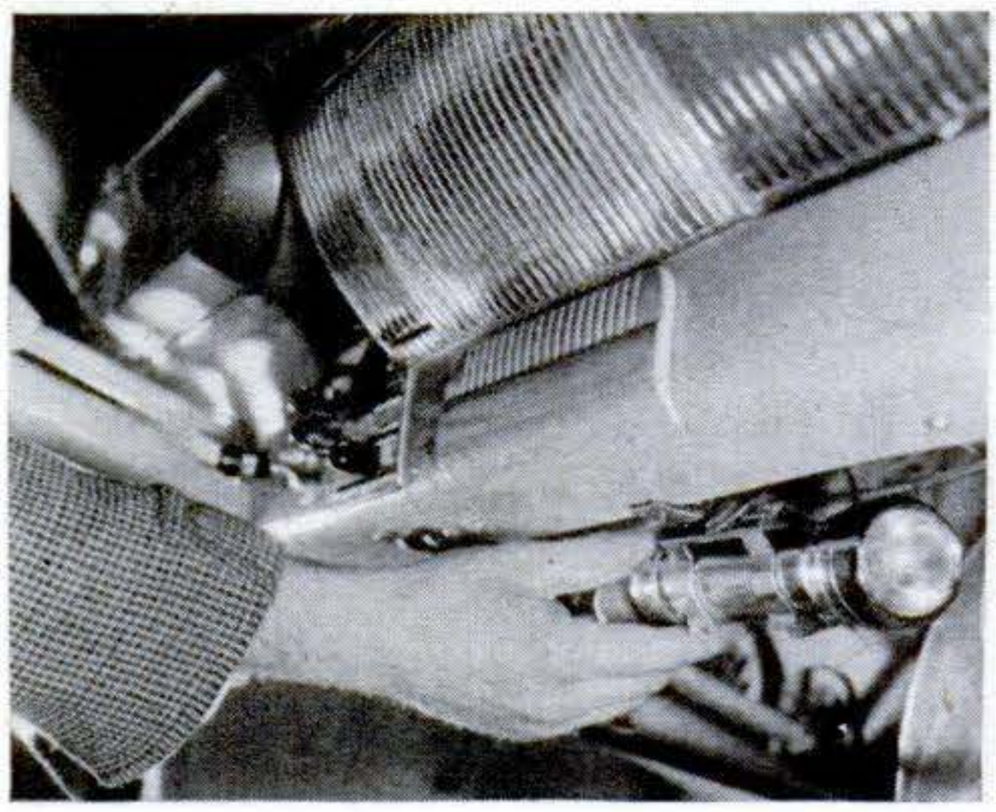
The maintenance tally I keep shows that I've spent $808.21 in seven years. To this I must add depreciation on the $275 worth of tools bought when I started my program. Most shops spread tool depreciation over 10 years; seven-tenths of $275 is $192.50. This brings total maintenance costs to $1000.71, or $142.95 per year. Insurance has cost me $438.85 and license fees, $108. That's $546.85, or $78.12 per year.

Lumping the yearly figures gives a total of $435.35. Divide this by 11,500 miles (my yearly average) and the result is 3.8 cents a mile for all expenses other than fuel. Here I use a liberal estimate of two cents a mile, based on 15 miles to the gallon at 30 cents a gallon.

Besides the low maintenance cost, there are the savings that will result from my car's flipping the 100,000 mark before I turn it in. Each year that I drive it costs less in depreciation, and I have found that maintenance costs don't rise as the car grows older, because I have kept it up properly. For example, I have never had to replace a front-end part.

With such maintenance, I can count on running the car those 100,000 miles. By then, I will have the price of a pretty flossy new automobile. As soon as I wrote off the price of my new tools in 1950, I started banking $30 a month. There will be no financing charges on my late 1958 model. END





2. Flashlight Is Kept Handy. Reach under the dash, and this flashlight is at your fingertips for an emergency. Held by a spring-clamp bracket mounted with a thumbscrew, it can be swiveled out of sight of pilferers.

3. Fitted Liner. A snap-in liner on the floor, sides and tailgate lets you stow cargo in a station wagon without scuffing the interior. Of heavy washable, plastic-coated material, it is made in sizes to fit all late station-wagon models.

More information *about these new car products can be obtained from: 1. Triangle Jack Co., Inc., Wichita, Kan.; 2. Burgess Battery Co., Freeport, Ill.; 3. The Wagonliner Co., 2406 E. Court St., Flint 3, Mich.; 4. Westwin Co., 170 Highland Ave., Kearny, N.J.*

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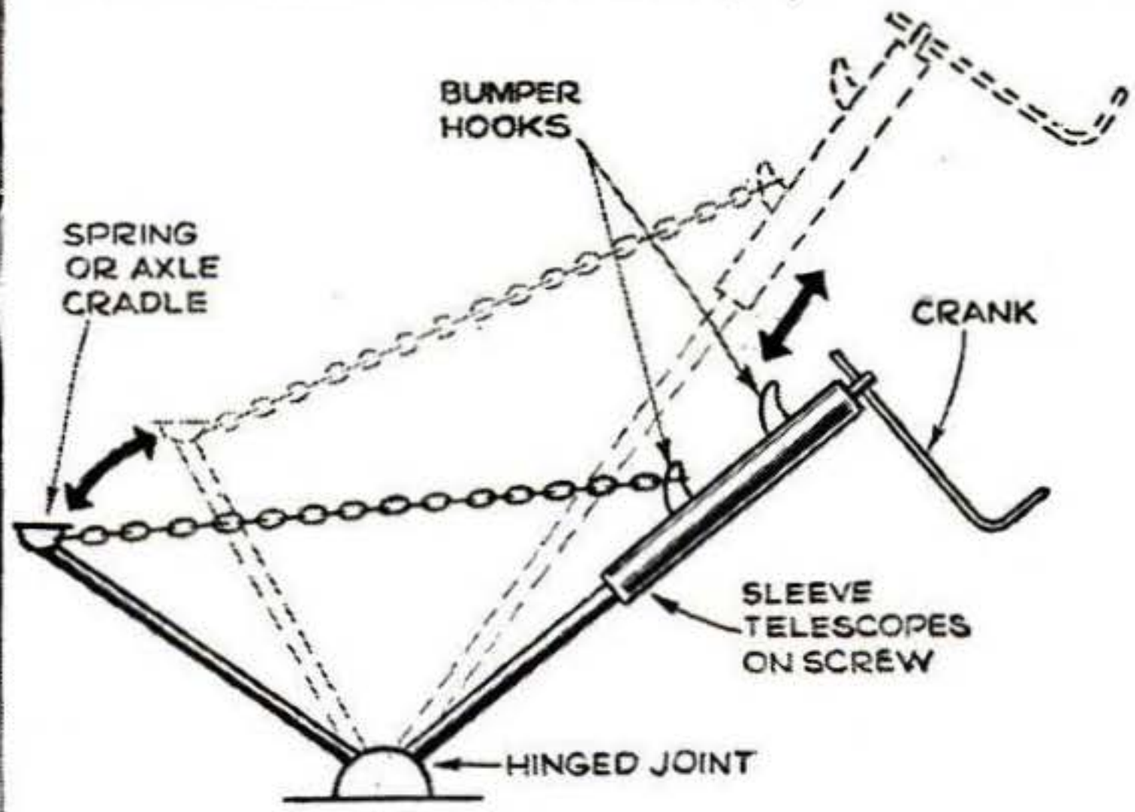
New for Your Car



1. Jack Gives Two-Point Lift. One cradle of a new triangle jack goes under the bumper, a second under the springs or axle. Then you turn a crank on the end of the screw-controlled bumper arm, and a chain draws up the axle arm with it. Result: The wheel is raised with the fender. The manufacturer says that the jack will hold a car safely on a grade or sloping shoulder without wheel chocks.

4. Flag Is Highway SOS. Unfurl this sign from the window of your stalled car to get a quick response on a busy throughway. The 12″-by-12″ flag has yellow reflective letters on a red field. It furls in a tube for storage.

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How to Choose the Right Amplifier

HI-FI REPORT

Here's the part that puts muscle in your hi-fi. Some makes put a lot of music in, too.

By Hubert Luckett and Robert Gorman

IF YOU had to pilot a car along a bumpy, winding road at 100 miles an hour—and never stray more than a quarter of an inch from the center-line—you might get some idea of the job an electronic amplifier takes in its stride.

This amazing little collection of tubes and wires is what makes radio, TV, telephones—and phonographs—work. It stays right on the road with signals that may weave millions of times a second. And it magnifies those signals.

The electronic amplifier is by all odds the most powerful magnifier ever invented. Mt. Palomar's giant telescope can enlarge images a paltry 1,500 times. But an ordinary amplifier, such as you might have in your own home, can increase signal power 100 *billion* times or more.

That kind of muscle is essential for hi-fi music systems. The power put out by some good pickup cartridges is awfully, awfully small—you'd need the energy from 10 million of them to light a flashlight bulb. But after the amplifier gets through with it, this puny signal is powerful enough to generate sound that will rattle windows a block away.

We tested and listened to 20 of the amplifiers listed in the specification chart on pages 214-15. What we found may help you save money—and hear better music.

How much? The chart lists only amplifiers selling for $100 or less. One reason for this limit is lack of space to include all amplifiers. But more important, we found that about $100 will buy as much amplifier quality as the rest of the average hi-fi system warrants. And amplifiers selling well under the $100 limit will give a lot of good listening.

Costlier amplifiers, which we did not try to cover, *are* better of course. They will even make the cheaper pickups and speakers sound better. We tried it. But, unless you blow fancy money—$600 up—on your rig, you'll get most music-per-dollar by sticking to a moderately priced amplifier and using any extra money to upgrade your other components.

What to compare. Key specifications, as supplied by the manufacturers, are listed in the chart. But, of course, you can expect variations. Our spot checks indicate that an average sample doesn't always meet its maker's specs.

In any case, you can't judge sound by figures alone. The engineers decide by listening, and you should do likewise. If possible, compare the sound of several units before you make a final choice.

Power. We monitored our test amplifiers with an output meter, which shows *average* power, and an oscilloscope, which reveals the *peak* output needed for very short, very loud tones. With ordinary recorded music—from solos to full symphony orchestra—average power runs around 0.3 watts but may jump to 1.5 watts. That's very loud music.

Peaks are another story. They shoot to nearly 20 watts. They go past so quickly, however, that you might not notice if your amplifier missed a few. Everything considered, a good amplifier with a rated output of 10 watts should

Fourth of a series on shopping for hi-fi components. Next month: Loudspeakers.

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HOW PS CHECKED AMPLIFIERS. The Luckett dining room looked like this as 20 of the amplifiers listed on the following pages were put through their paces. Power output was checked with oscilloscope (at Luckett's right) and output meter (next to scope). Big speaker (background) was used for the listening tests.

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HI-FI AMPLIFIER SPECS

MAKE AND MODEL	PRICE	RATED OUTPUT (watts)	INTERMODULATION DISTORTION		FREQUENCY RESPONSE (cycles)		POWER OUTPUT AT 30 CYCLES (watts)	DAMPING FACTOR	OUTPUT TRANSFORMER CORE	
			At Rated Output	At 1-Watt Output	At Rated Output	At 1-Watt Output			Material	Size (cu. in.)
MASCO CM-8	$39.44	8	n.s.	n.s.	20-20,000 ±1 db	20-20,000 ±0.25 db	6	n.s.	silicon steel	3
GROMMES LJ-5	$39.50	10	3%	0.6%	40-12,000 ±1 db	20-20,000 ±1 db	4	4	audio iron	5.6
BELL 2285	$49.95	10	4.9%	n.s.	n.s.	20-20,000 ±1 db	5.1	2.1	n.s.	n.s.
HARMAN-KARDON PRELUDE	$55.00	10	3%	0.3%	30-10,000 ±1 db	20-20,000 ±0.5 db	10	6	n.s.	n.s.
GROMMES 10 PG	$57.50	10	3%	0.4%	30-10,000 ±1 db	20-20,000 ±0.5 db	7.5	10	audio iron	9.4
LAFAYETTE LA-54A	$59.50	12	2%	0.1%	20-20,000 ±1 db	17-25,000 ±0.5 db	5	15	audio iron	n.s.
BOGEN DB110	$59.95	12	2%	0.5%	8-30,000 ±2.5 db	15-30,000 ±0.5 db	12.5	infinite	silicon steel	6
ALLIED (KNIGHT) BANTAM	$64.50	12	2%	.1%	20-20,000 ±0.5 db	20-20,000 ±0.5 db	11	.03 to 8	silicon steel	7.5
LAFAYETTE LA-59	$64.50	18	2%	n.s.	20-40,000 ±1 db	n.s.	5	15	audio iron	n.s.
CRAFTSMAN CA-II	$65.00	10	3%	0.5%	30-10,000 ±1 db	20-20,000 ±1 db	10	6	audio iron	n.s.
STROMBERG-CARLSON 411	$65.00	10	3%	0.5%	50-17,000 ±2 db	10-30,000 ±1 db	5	10	audio iron	5.3
GROMMES 15 PG	$69.50	12	2%	0.25%	30-15,000 ±1 db	20-30,000 ±0.5 db	12.2	10	audio iron	11.3
RCA SVP-10-A	$69.95	10	2.5%	0.5%	8-30,000 ±2.5 db	15-30,000 ±0.5 db	12.5	infinite	silicon steel	6
MASCO CM-10	$70.13	10	1%	0.2%	20-20,000 ±0.5 db	20-20,000 ±0.1 db	15	n.s.	silicon steel	15.1
PILOT AA903B	$74.50	14	1.5%	0.1%	20-20,000 ±1 db	10-50,000 ±2 db	14	20	silicon steel	8
BOGEN DB115	$75.00	15	0.8%	0.2%	15-30,000 ±2 db	15-30,000 ±0.5 db	15	infinite to −1.5	silicon steel	6
STROMBERG-CARLSON 415	$75.00	12	2%	0.25%	40-18,500 ±1 db	20-50,000 ±0.5 db	6	11	audio iron	6
LAFAYETTE LA-66	$79.50	35	2%	0.1%	20-40,000 ±0.5 db	15-55,000 ±0.5 db	6	15	audio iron	n.s.
SONOTONE HFA 150	$79.50	15	1%	0.5%	20-20,000 ±1 db	20-20,000 ±1 db	15	16	silicon steel	10
NATIONAL HORIZON 10	$79.95	10	2%	n.s.	20-20,000 ±1 db	n.s.	n.s.	n.s.	n.s.	n.s.
RAULAND-BORG 1512	$88.80	12	4%	1%	20-20,000 ±1 db	20-20,000 ±1 db	8	.03 to 8	silicon steel	7.5
GROMMES 20 PG	$89.50	20	2%	0.1%	27-20,000 ±1 db	15-30,000 ±0.5 db	21	9	audio iron	17.8
ALLIED (KNIGHT) DELUXE	$94.50	24	2%	0.4%	20-40,000 ±0.75 db	20-40,000 ±0.5 db	28.5	.06 to 11	silicon steel	16.4
HARMAN-KARDON MELODY II	$95.00	20	2%	0.15%	20-20,000 ±1 db	20-20,000 ±0.5 db	20	20	n.s.	n.s.
BOGEN DB20	$99.00	20	1.3%	0.27%	8-28,000 ±0.5 db	8-30,000 ±0.5 db	25	13	audio iron	16.4
ELECTRO-VOICE A15CL	$99.50	15	1.2%	0.2%	20-20,000 ±1 db	20-20,000 ±1 db	14	0.1 to 15	audio iron	6.2
GENERAL ELECTRIC A1-320	$99.50	20	2.4%	n.s.	30-15,000 ±2 db	20-20,000 ±1 db	20	10	n.s.	n.s.
PILOT AA920	$99.50	20	1.5%	0.1%	20-20,000 ±1 db	10-50,000 ±2 db	20	10	silicon steel	13.5
SHERWOOD S-1000 II	$99.50	20	1%	0.2%	20-30,000 ±1 db	15-30,000 ±0.5 db	19.5	2, 16, −2	silicon steel	10.1
H.H. SCOTT 99-C	$99.95	22	0.3%	0.05%	30-20,000 ±1 db	20-30,000 ±1 db	17	5	silicon steel	12
STROMBERG-CARLSON 419	$99.95	20	1.5%	0.25%	40-20,000 ±1 db	20-50,000 ±0.5 db	10	11	audio iron	7.5
KITS										
HEATHKIT A-7E	$20.35	7	3.3%	1.2%	28-23,000 ±1 db	10-37,000 ±1 db	4.5	4.3	silicon steel	3
HEATHKIT A-9B	$35.50	20	4%	1.8%	30-20,000 ±1 db	20-20,000 ±1 db	12.3	8	silicon steel	10.2
EICO HF-20	$49.95[b]	20	1.3%	0.5%	17-40,000 ±0.3 db	12-40,000 ±0.2 db	27	7	silicon steel	20
HEATHKIT W-4A	$59.50	20	2.7%	0.1%	20-20,000 ±1 db	10-100,000 ±1 db	20+	28.5	silicon steel	11.5
HEATHKIT W-3	$69.50	20	1.3%	0.1%	20-20,000 ±1 db	6-150,000 ±1 db	20	20	silicon steel	15
TECH-MASTER 15A/17P	$69.90	20	0.5%	0.1%	10-70,000 ±1 db	8-100,000 ±1 db	20	5	silicon steel	12
HEATHKIT W-5	$79.50	25	1.6%	0.1%	25-15,000 ±0.5 db	5-160,000 ±1 db	23	40	silicon steel	8.6

NOTES: **n.s.** Information not specified by manufacturer

[a]This test (see text) does not represent normal amplifier operation, but does give a partial clue to the relative margin of stability. Figures are for the smallest pure capacitive load, across the output of the amplifier, that will cause oscillation under the stated signal condition

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OUTPUT IMPEDANCE TAPS (ohms)	STABILITY MARGIN (see footnote a)		NOISE AND HUM BELOW RATED OUTPUT (db)	AMPLIFIER INPUTS						INDIVIDUAL LEVEL CONTROLS	SIGNAL STRENGTH FOR RATED OUTPUT (millivolts at magnetic input)	NUMBER OF RECORD EQUALIZATION CHOICES	EXTRA CONTROLS			AC CONVENIENCE OUTLETS	INSTALLATION DATA			
	No Input (mfd.)	40-Cycle Input (mfd.)		MAGNETIC	CRYSTAL	TUNER	MICROPHONE	TAPE	OTHER				LOUDNESS	SCRATCH FILTER	RUMBLE FILTER		MOUNTING POSITION	DRESS-UP COVER	CHASSIS STYLE	DIMENSIONS (width x height x depth in inches)
4, 8, 16	n.s.	n.s.	60	1	1	1	0	0	0	none	10	1	no	no	no	1	any	none	conven.	10 x 5½ x 7
4, 8, 16	.06	.02	50	1	1	1	0	0	1	none	5	3	no	no	no	1	any	none	conven.	10 x 6 x 6
4, 8, 16	n.s.	n.s.	44	1	1	1	0	0	0	none	9	1	no	no	no	1	any	incl.	flat	11½ x 3½ x 9
8, 16	n.s.	n.s.	50	1	0	1	0	1	2	none	8	3	yes	no	yes	1	any	incl.	flat	12⅝ x 4⅛ x 7⅛
4, 8, 16	.045	.06	55	1	1	1	0	0	3	none	5	3	yes	yes	yes	2	any	incl.	flat	12¾ x 4 x 9
4, 8, 16	n.s.	n.s.	70	1	1	2	0	1	0	none	8	24	yes	no	yes	1	any	incl.	flat	10⅞ x 4½ x 8
4, 8, 16	unlim.	unlim.	60	2	0	1	1	0	1	none	4.6	2	no	yes	no	2	horiz.	opt.	conven.	11 x 5¼ x 7¼
8, 16	unlim.	unlim.	55	2	1	1	0	0	3	tuner	15	3	yes	no	no	2	any	incl.	flat	13 x 3½ x 10½
4, 8, 16	n.s.	n.s.	70	1	1	2	0	1	0	none	8	24	yes	no	yes	1	any	incl.	flat	11½ x 4½ x 8½
4, 8, 16	.009	.009	55	1	1	1	0	1	1	none	8	12	yes	no	no	1	any	incl.	flat	13 x 4½ x 7½
4, 8, 16	unlim.	n.s.	60	1	1	1	0	0	1	none	8	6	no	no	no	0	any	incl.	flat	14 x 4¾ x 9½
4, 8, 16	.09	.1	56	1	1	1	0	0	3	none	8	16	yes	yes	yes	2	any	incl.	flat	12¾ x 4 x 9
4, 8, 16	unlim.	unlim.	60	1	1	1	0	0	1	none	10	1	no	no	no	2	horiz.	none	conven.	11 x 7-5/16 x 7
4, 8, 16	n.s.	n.s.	80	1	1	1	0	0	1	none	10	5	yes	no	no	2	any	none	conven.	12 x 8 x 7
4, 8, 16	.005	.004	80	2	0	1	0	0	2	magn.	3	4	yes	yes	yes	1	any	incl.	flat	13¼ x 4¾ x 9
4, 8, 16	unlim.	unlim.	65	1	1	1	0	1	1	none	7	4	yes	yes	yes	1	any	opt.	flat	11¾ x 4⅛ x 10¼
4, 8, 16, 150, 600	unlim.	n.s.	80	2	1	2	0	0	2	none	6	4	yes	no	no	1	any	incl.	conven.	11 x 7 x 8
4, 8, 16	n.s.	n.s.	85	1	2	2	0	1	0	none	8	24	yes	no	yes	2	any	incl.	flat	12⅛ x 4⅛ x 9¾
8, 16	unlim.	unlim.	60	1	1	1	0	1	2	tuner, tape, aux.	5	1	yes	yes	yes	1	any	opt.	flat	12 x 3 x 7
8, 16	n.s.	n.s.	50	1	0	1	0	1	0	magn.	10	3	yes	no	yes	1	any	incl.	flat	14½ x 4 x 12¼
8, 16	unlim.	unlim.	55	2	1	1	1	1	0	tuner	15	1	no	no	no	2	horiz.	incl.	flat	13 x 3½ x 10½
4, 8, 16	unlim.	unlim.	60	1	1	1	0	0	3	none	8	16	yes	yes	yes	2	any	incl.	flat	12¾ x 4¾ x 9
8, 16	unlim.	unlim.	60	2	1	1	0	0	3	tuner	15	9	yes	yes	yes	2	any	incl.	flat	15⅝ x 4¼ x 11½
4, 8, 16	n.s.	n.s.	60	1	0	1	0	1	2	magn.	6	3	yes	no	yes	2	any	incl.	flat	12½ x 3¼ x 7¼
8, 16	.047	.03	69	2	0	1	0	1	1	none	3.7	6	yes	yes	yes	2	horiz.	opt.	conven.	15¼ x 8 x 10
4, 8, 16	unlim.	unlim.	60	1	1	1	0	0	2	none	10	2	no	no	no	1	any	incl.	flat	15 x 4⅛ x 12
4, 8, 16	n.s.	n.s.	56	2	0	1	0	0	2	tuner, aux.	10	5	yes	no	yes	2	any	incl.	flat	15 x 5⅝ x 13¼
4, 8, 16	.0025	.002	80	2	0	1	0	0	2	magn.	3	4	yes	yes	yes	1	any	incl.	flat	13¼ x 4¾ x 9
4, 8, 16	.022	.01	60	2	1	1	0	0	1	magn.	3	4	yes	yes	yes	1	horiz.	incl.	flat	14 x 4 x 10½
4, 8, 16	unlim.	unlim.	70	2	1	1	0	1	1	magn.	8	5	yes	yes	yes	1	horiz.	opt.	flat	15 x 4⅜ x 12
4, 8, 16	unlim.	n.s.	80	1	1	1	0	0	2	none	8	6	no	no	no	1	any	incl.	flat	14 x 4¾ x 9½
4, 8, 16	n.s.	n.s.	53	1	0	1	0	0	0	none	10	1	no	no	no	0	horiz.	none	conven.	11½ x 5¾ x 6⅝
4, 8, 16, 500	.003	.002	50	1	1	1	1	0	0	none	8	2	no	no	no	0	horiz.	none	conven.	14 x 7⅜ x 8⅞
4, 8, 16	.005	unlim.	60	2	1	1	0	0	1	none	6.5	5	yes	no	no	2	horiz.	opt.	conven.	15 x 8½ x 8
4, 8, 16	.013	.017	62	1	1	2	1	0	0	all	4.9	16	no	no	no	1	horiz.[c]	none	two chassis	15¼ x 7 x 8⅞[d]
4, 8, 16	.005	.013	62	1	1	2	1	0	0	all	5	16	no	no	no	1	horiz.[c]	none	three chassis	11 x 7 x 5½ (two)[d]
4, 8, 16	.1	n.s.	66	1	1	1	0	1	0	none	5	3	no	no	no	1	any	incl.	two chassis	12 x 6½ x 9[e]
4, 8, 16	.025	.08	62	1	1	2	1	0	0	all	5	16	no	no	no	2	horiz.[c]	incl.	two chassis	13⅛ x 8 x 8½[d]

[b] Available completely wired at $79.95
[c] Power amplifier only; separate preamplifier can be mounted in any position
[d] Power amplifier(s) only; separate preamplifier measures 12-9/16" x 3⅝" x 4⅞"
[e] Power amplifier only; separate preamplifier measures 9⅞" x 3⅜" x 4½"

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be enough. It should handle a 20-watt peak without strain.

The transformer. One reason power costs money is that it needs a husky, well-designed output transformer. The type and amount of the transformer core material give useful clues to an amplifier's power-handling ability. For cores, grain-oriented silicon steel rates tops with the experts; you need less of it than of the more conventional "audio iron."

The design of other circuit elements also influences clean power output. The net effect of circuitry and transformer is roughly indicated by an amplifier's power output at 30 cycles.

Distortion. One clue to the quality of an amplifier's sound is the percentage of intermodulation (IM) distortion. The amplifier causes this when it combines different musical tones to make new tones that were not present in the original music. Naturally, the lower this distortion, the better.

Frequency response. This is the figure you see advertised most: the range of sound frequencies an amplifier can handle, and the way it handles them. A completely "flat" amplifier reproduces its full range uniformly—that is, without emphasizing or diminishing any tones.

Critical listeners may haggle about how broad and flat response should be, but it's safe to require a minimum range of 40 to 12,000 cycles at full rated output. Variations from "flat" should be no more than two decibels (db).

Damping factor. When the mechanical parts of a loudspeaker are set in motion—especially by sudden bursts of sound—they want to keep on vibrating. Unless the amplifier "damps" the speaker by a kind of electrical braking action, these "hangover" vibrations may slur the sound. A damping factor of five or more should be enough.

Stability. An amplifier should never make a sound—only magnify signals fed to it. Sometimes an amplifier becomes an almost-oscillator—a tone generator—when the designer tries to eliminate the last bit of distortion without increasing cost. This is okay until parts change with age, tubes weaken or line voltage drops. Then a loud note may push the almost-oscillator over the borderline. It oscillates.

You may hear the oscillation as a squeal or a lower-pitched "motorboating" sound. It may also be inaudible—a frequency humans cannot hear—but even this makes music sound harsh.

We found that three of our amplifiers were borderline oscillators, even though brand-new. Two generated an inaudible oscillation without any special pushing; one gave a low-pitched tone when pushed by a peak note. These seem to have been production-line freaks that sneaked past inspection, but our test findings do emphasize something to watch out for when you buy.

There is no standard measurement of stability margin, so we asked each manufacturer to determine the smallest capacitive load that would cause his amplifier to oscillate in two separate tests. Figures in the chart's first column under "Stability Margin" were obtained with no signal, those in the second column with the amplifier driven hard by a 40-cycle sine wave. In both cases, higher capacitance is a clue to greater stability margin. Several manufacturers stated that their amplifiers could not be made to oscillate with any reasonable capacitive load. This is listed as "unlimited."

Input jacks. You don't have to play technical guessing games to decide on the input connections your amplifier needs. Just add up the record players, radio tuners, tape decks, or microphones you now have or plan to add.

If your amplifier has one or more individual level controls, you can match signal inputs and not have to worry about sound blasting out at you when you switch, say, from radio to phono.

The amount of signal input an amplifier needs in order to deliver its rated output affects your choice of pickup. Make sure the required signal input is as low as the output voltage of your pickup, or lower. (See PS, Nov. '56, p. 214, for data on pickups.) If you plan to use a

[Continued on page 246]

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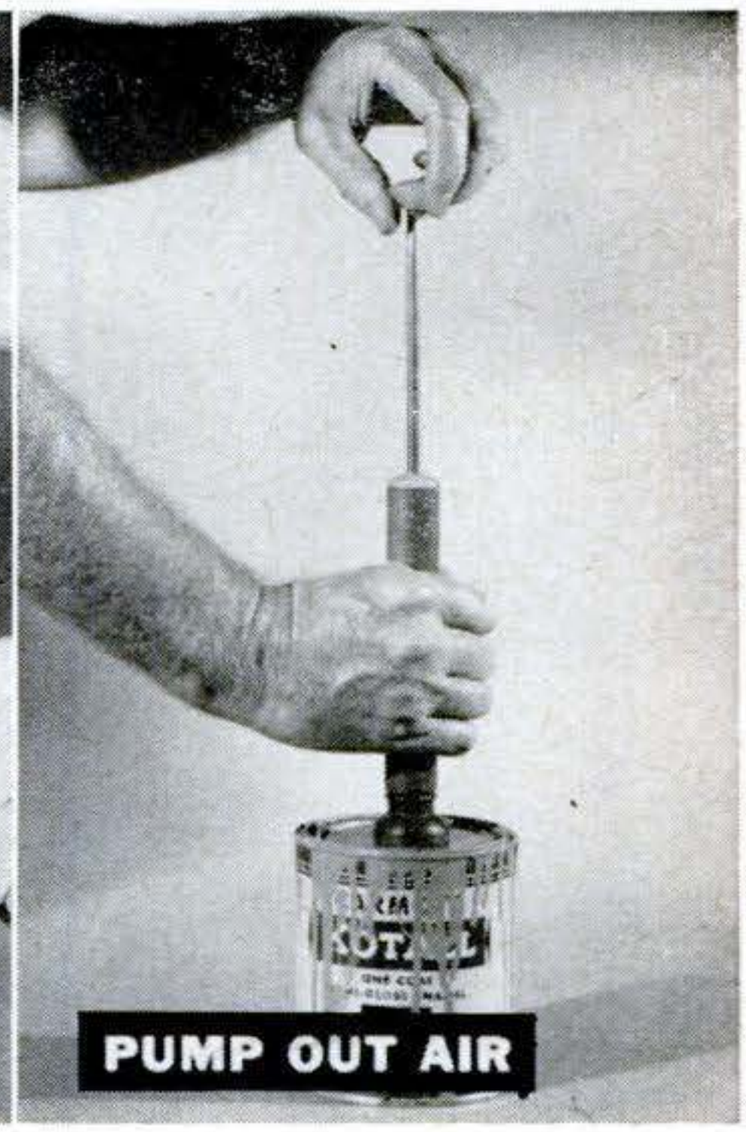
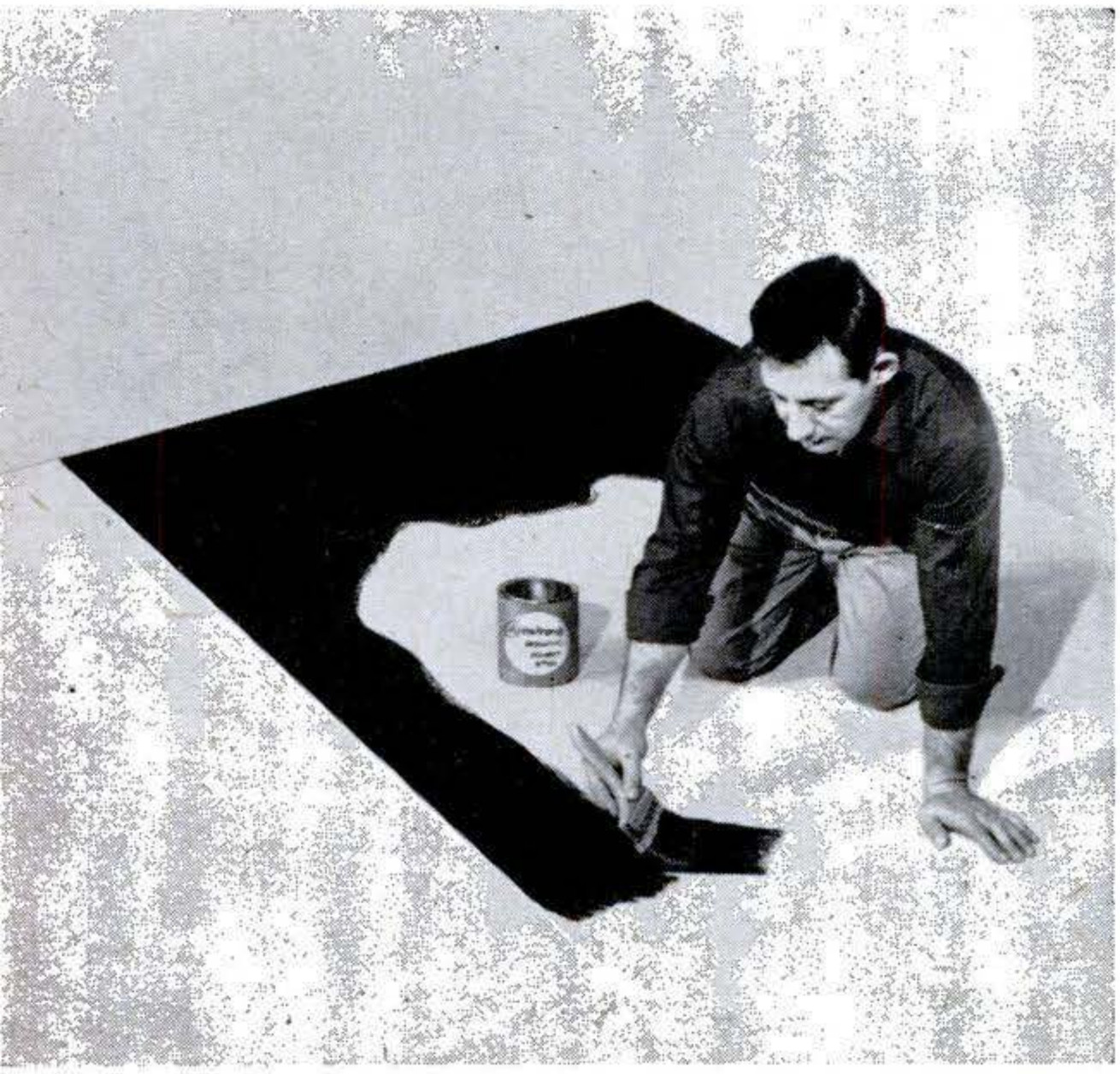
New for the Handyman



1. Vacuum Seals Paint Can. Hardening of paint, wood sealer, glue and the like in a half-emptied can is always a problem. A new vacuum sealer pumps out entrapped air after the can has been capped tight and is said to retard oxidation. You punch a hole in the lid, seal it with a rubber flap and then pump. Finally, reseal the flap against leakage by pressing it down again.



2. Floor Mastic Brushes On. A new adhesive for composition floor tile makes use of a notched trowel unnecessary. You simply spread it with a paintbrush. Developed for vinyl-asbestos tile, it can be used on a wood or a concrete base.

3. Screw Assortment in Handy Case. The most-used sizes of stove bolts and wood and sheet-metal screws are easy to keep in a container that holds them in individual boxes, label side up. They are packed in two assortments: both bolts and screws, and just wood screws. Refill boxes can be bought separately.

More information *about the products shown on this page can be obtained from: 1. The B & S Co., P.O. Box 1840, New Haven, Conn.; 2. Armstrong Cork Co., Lancaster Pa.; 3. Southern Screw Co., P.O. Box 1360, Statesville, N.C.*

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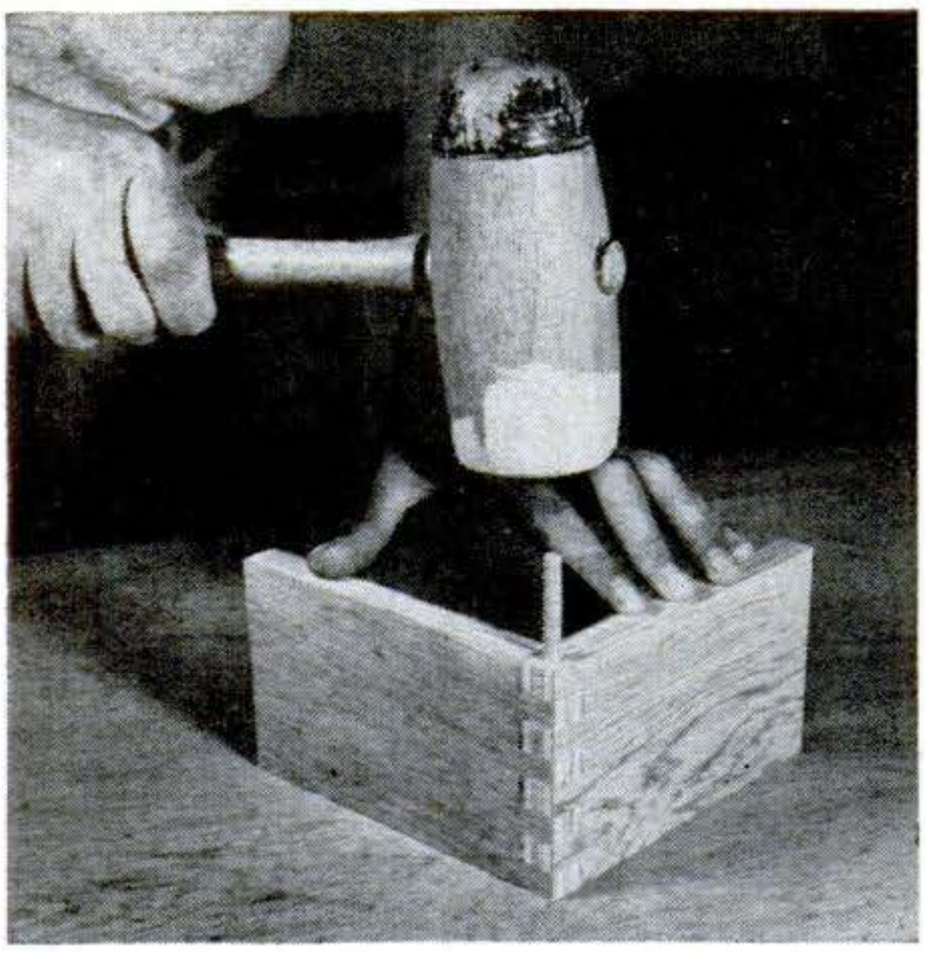
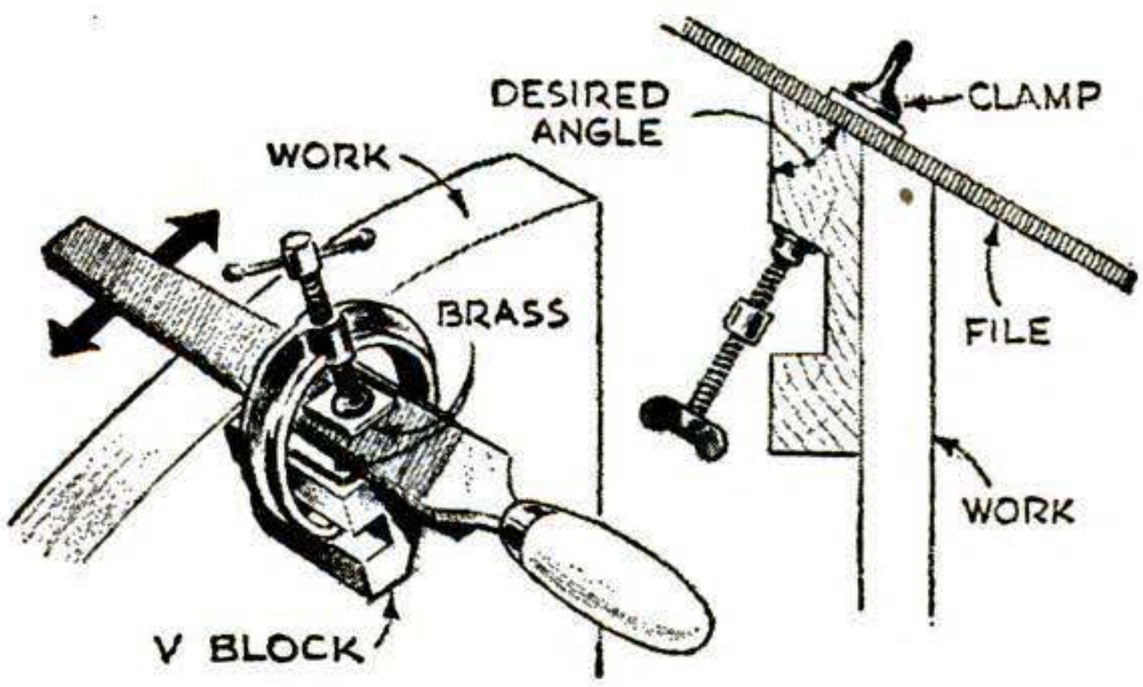
PS Shop Notebook



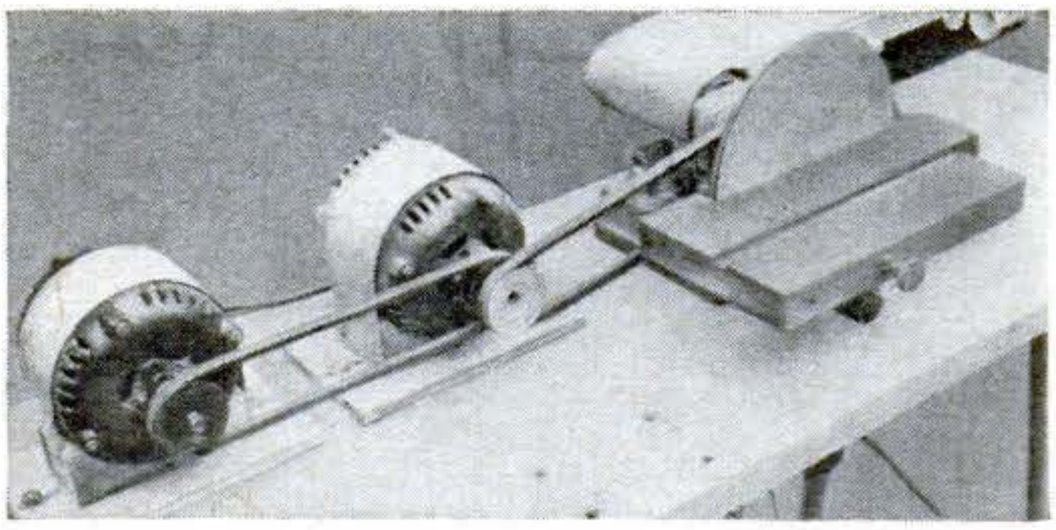
Locked Finger Joint

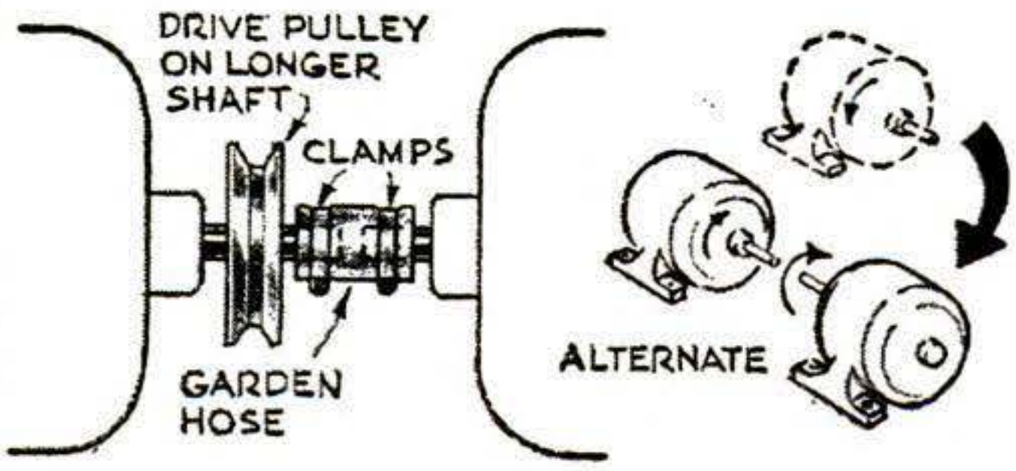
Strong as dovetail joints and easier to make, finger joints locked with dowels cannot be pulled apart either way. Cut and assemble the parts; then drill through all the fingers (in ¾″ stock, use a ¼″ hole). The dowel should be snug but not so tight as to split the fingers. Chamfer one end, coat the dowel with glue, and tap it in. Sand the ends flush. —*R. J. DeCristoforo, Los Altos, Calif.*



Filing Aid

Draw-filing edges square is easier with the file clamped in a V block (far left). Put brass between to protect the block surface. For angle filing, make up a block as at left with a notch in which the file can be clamped. —*G. Schlenk, Drexel Hill, Pa.*





Two-Motor Power

Doubling up light motors can save you the high cost of a big one. Two ¼-hp. motors, for example, deliver ½ hp. to the sander above. Both motors should be of the same speed rating. Use two pulleys on the machine, belting one motor to each, or hook them in tandem as shown (the belt joining them must run on same-size pulleys). Couple single-ended motors, turning oppositely, as above.—*C. T. Pearson, Ypsilanti, Mich.*

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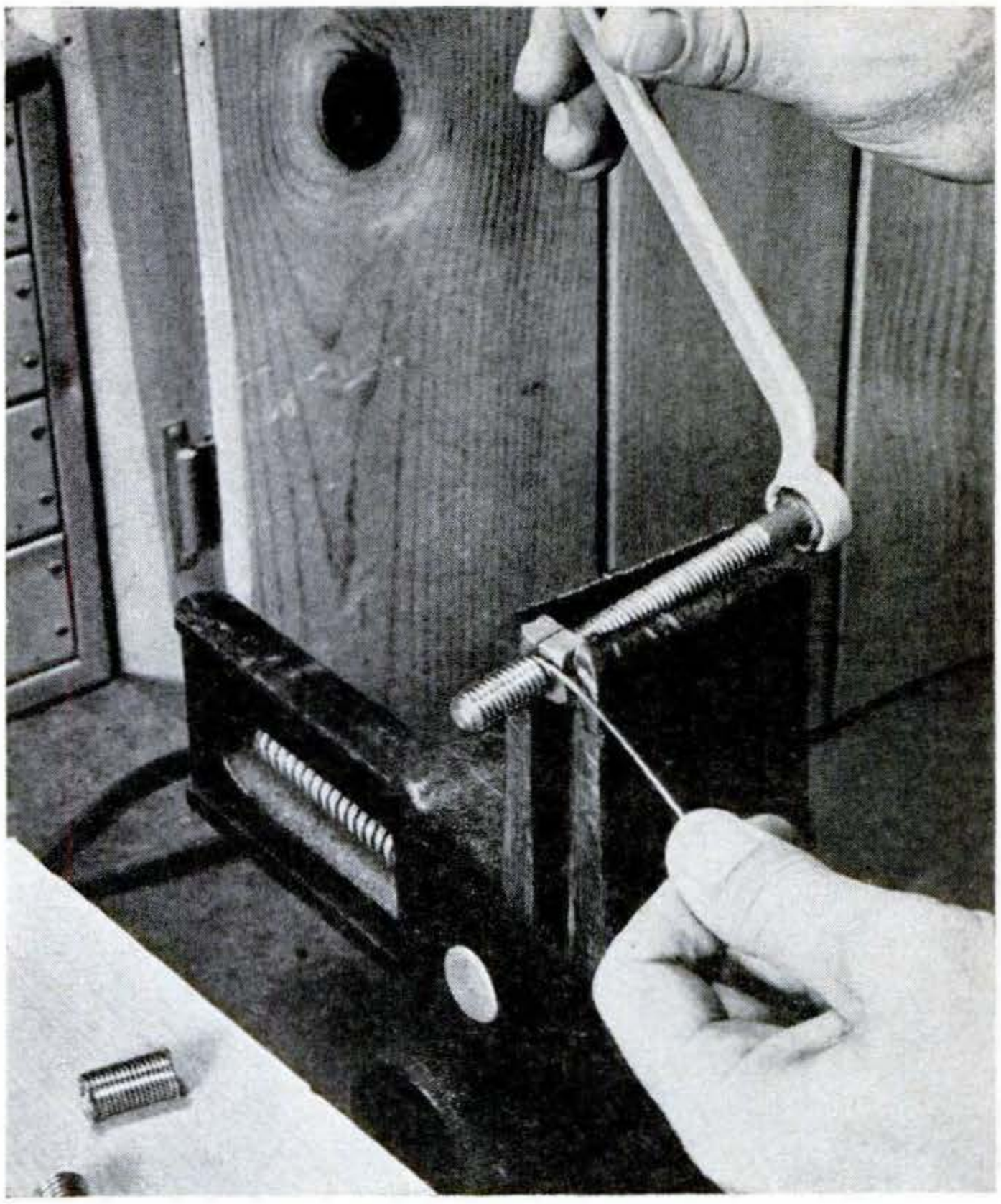
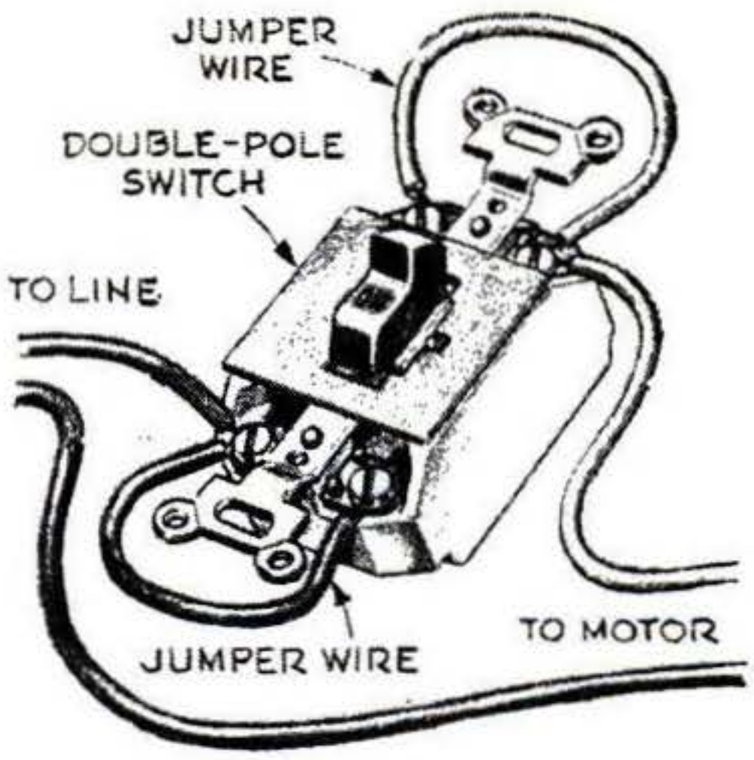
Winding Springs

Special springs can be wound with a suitable bolt and nut. Drill a small cross hole near the end of a bolt somewhat smaller than the desired spring diameter. Saw through one side of the nut. Tighten a vise on the nut as shown until you cannot turn the bolt with the fingers. Bend a hook on the end of steel music wire, insert the hook in the hole, and turn the bolt with a wrench, keeping the wire taut meanwhile.





Heavy-Duty Switch

Cutting the juice off a shop motor is rough on the ordinary toggle switch. For ⅓- to ½-hp. motors, choose a T-rated switch designed for heavy duty. If you cannot find one of sufficient capacity, use a double-pole switch of at least half the necessary rating. Wire the two halves of it together with jumper wires as shown; connect it in series with one power lead to the motor in the usual way.

Keeping Coolant Rust-Free

A few drops of soluble cutting oil in the water used to cool tools when grinding will keep it from turning rusty. Use just enough to make the water milky; too much forms a film. —*Robert V. Thompson, Clinton, Iowa.*

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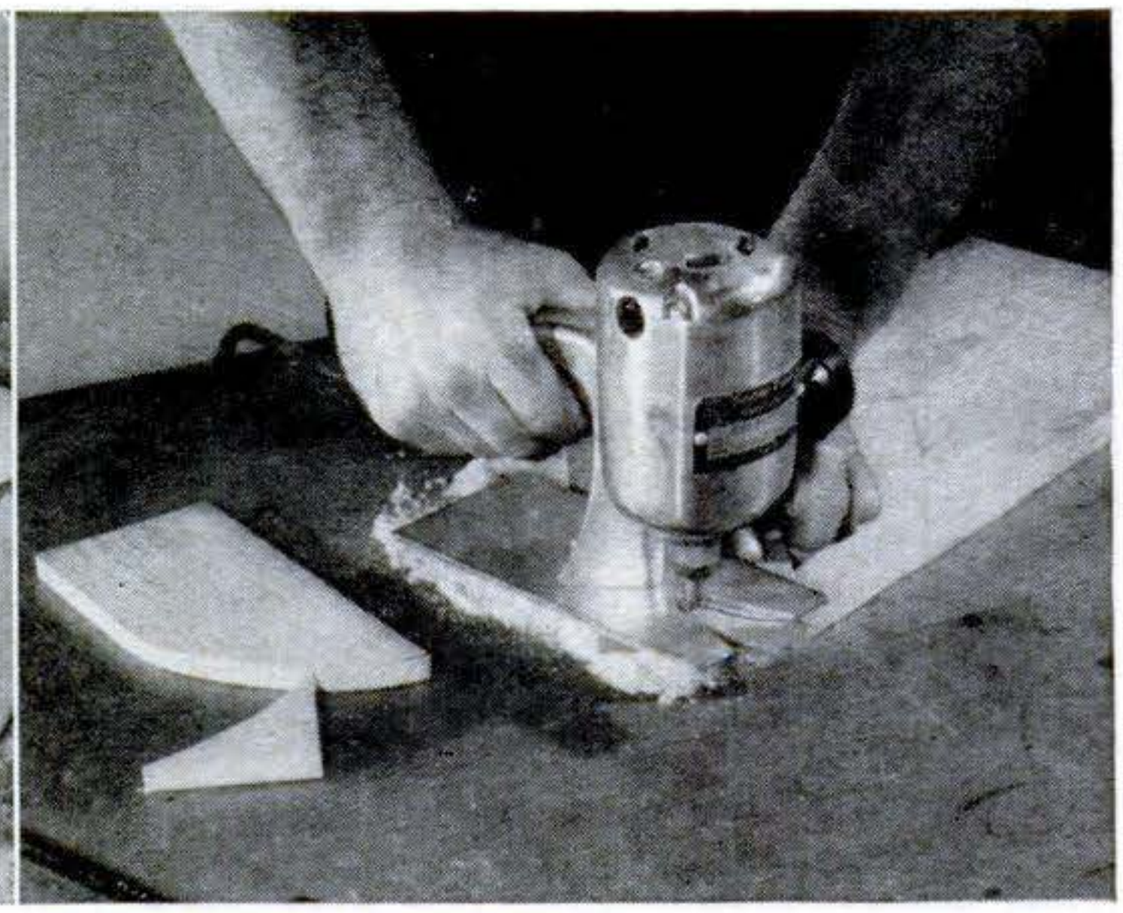
Husky Motor Drives Six Tools

ALTHOUGH not intended to be a complete workshop in a single tool, a new line of accessories built around a high-speed router handles a wide range of operations.

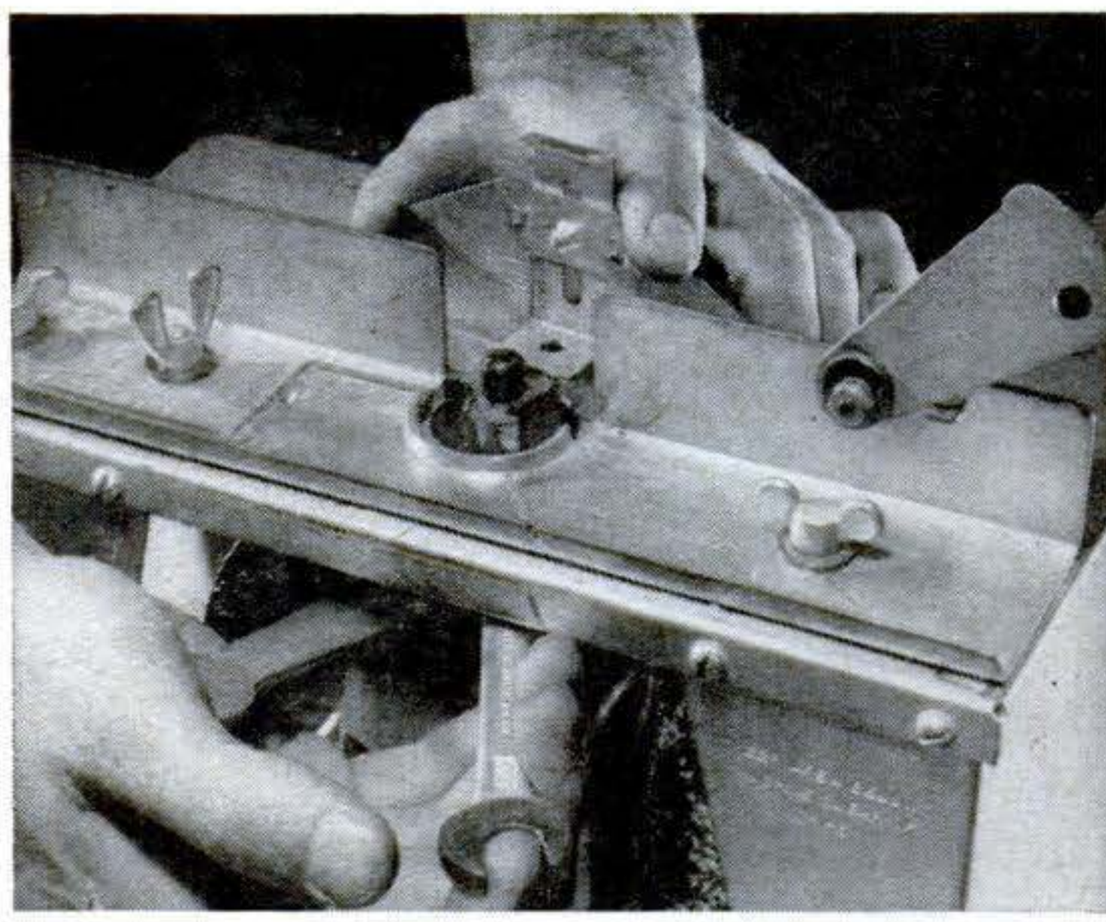
The 24,000-r.p.m. power head was introduced last year. It can now be quickly converted into five different portable power tools plus a lawn trimmer.

The ⅜-hp. router, made by Porter-Cable, sells for $42.50. With it come certificates redeemable at tool dealers until Jan. 31, 1957, for savings totaling $20 on purchase of the accessories.

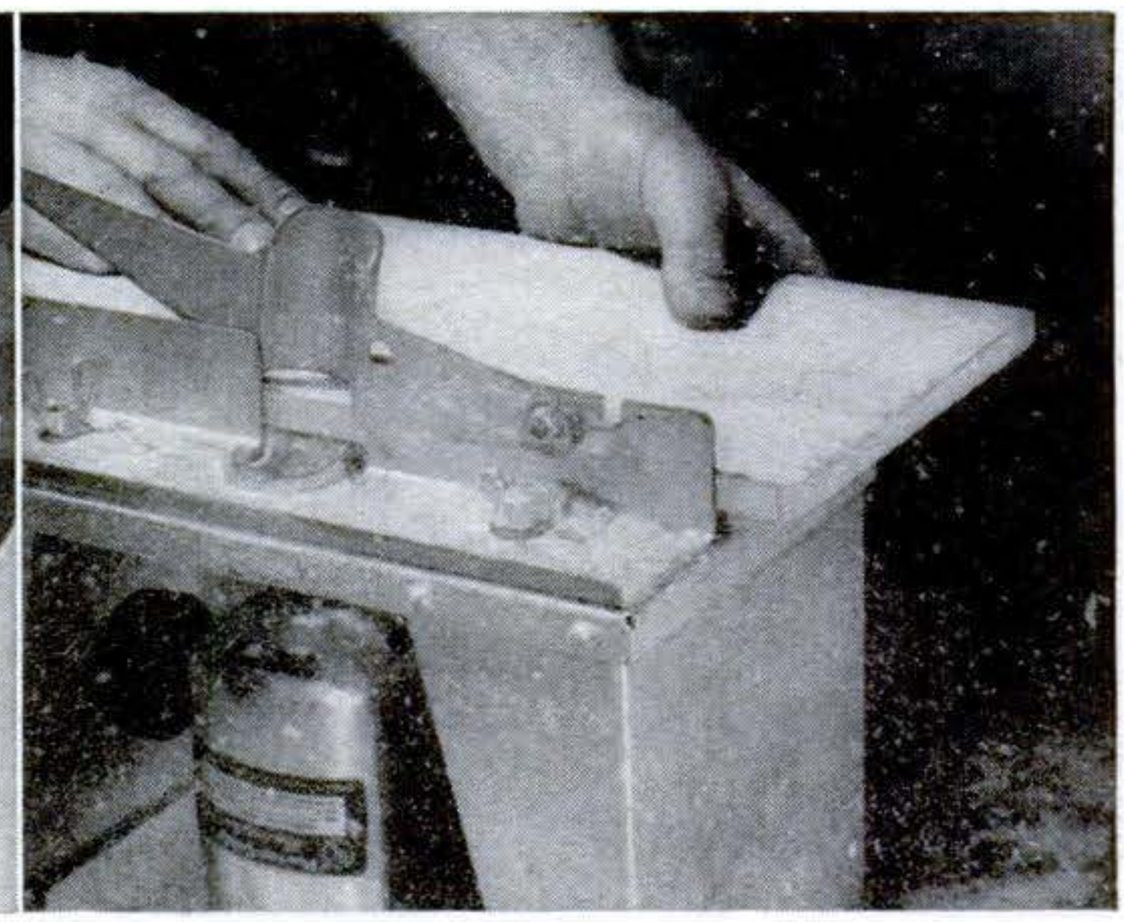
AS A ROUTER, with its guide attached, the tool plows dadoes parallel with the work edge. Its capabilities are increased by a variety of bits for shaping decorative edges on either wood or plastic, or for routing designs in relief.



IT BECOMES A JIGSAW if you change the base and lock a spiral bit in the chuck. A guide pin helps cut curves. Used with a fence clamped to the work, it makes straight rip cuts. It starts inside cuts without requiring predrilling.



FASTENED TO A SHAPER TABLE, it cuts all standard ornamental designs on board edges or picture-frame moldings. A depth gauge is included with the router for setting cutter height. Both fences of the table are adjustable.



CHIPS FLY SAFELY AWAY from the operator. The guard rides the work to keep fingers away from the cutting area. With a planing cutter in the chuck, the shaper table can be used as a jointer for work that is up to 1¾" wide.

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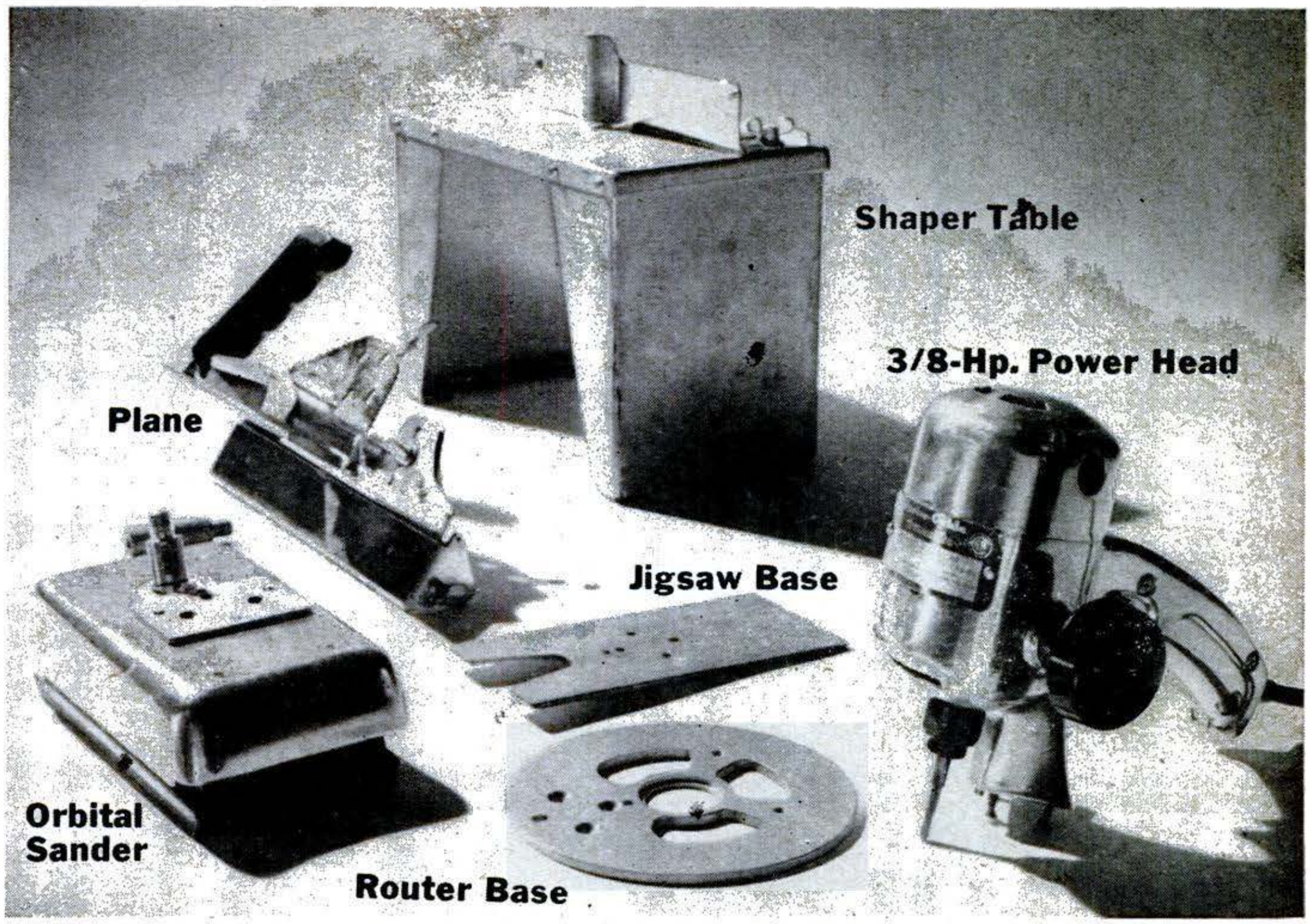
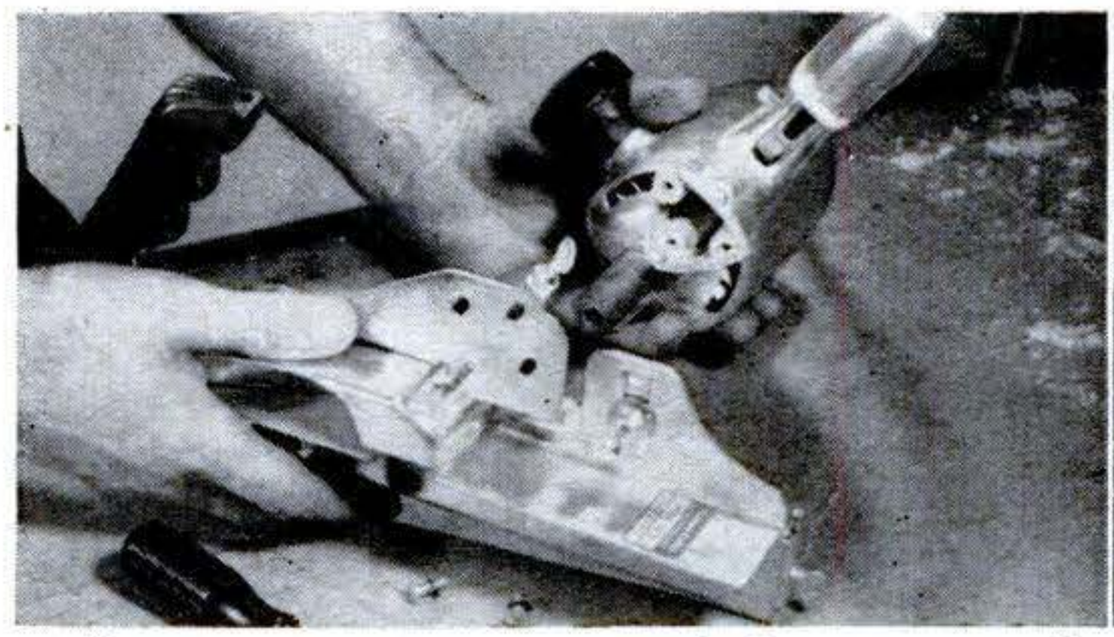
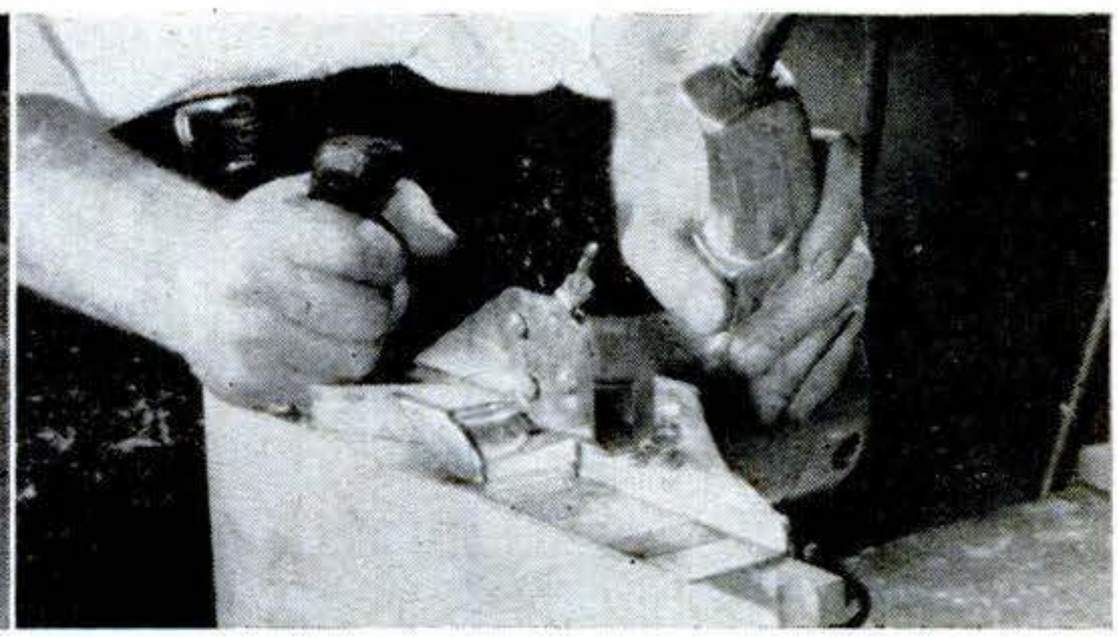


There's less need to group similar cuts. The power head changes quickly to suit the job.



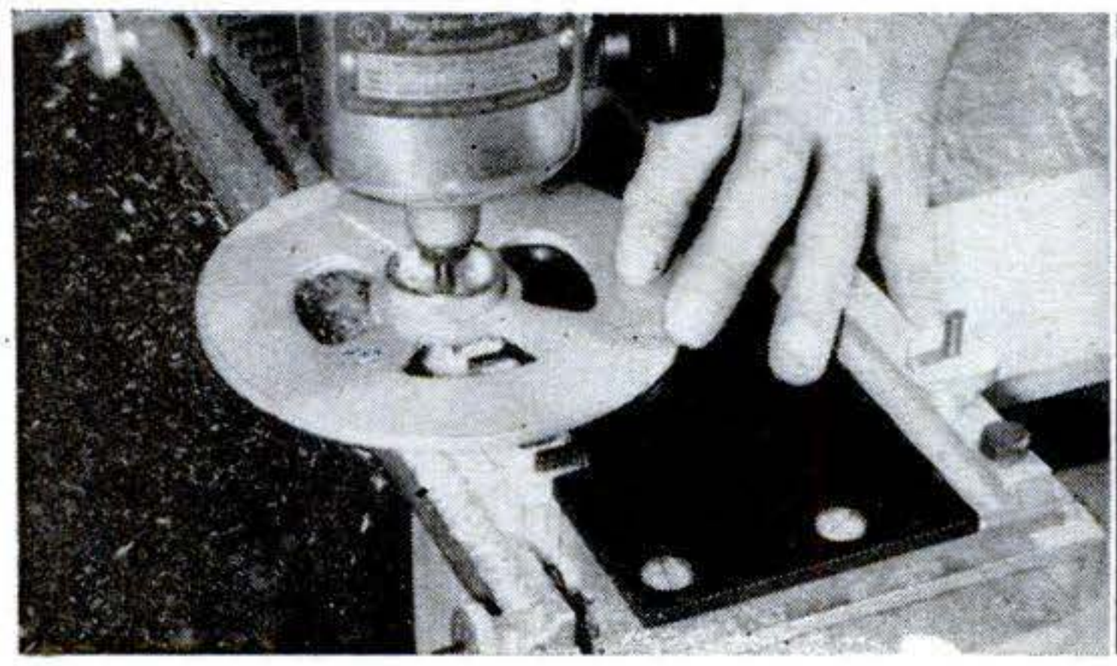
JUST THREE SCREWS are used for every tool changeover. Index pins line up each accessory correctly before it is fastened in position. The plane has elongated holes for setting the cutter within range of the adjustable sole plate.

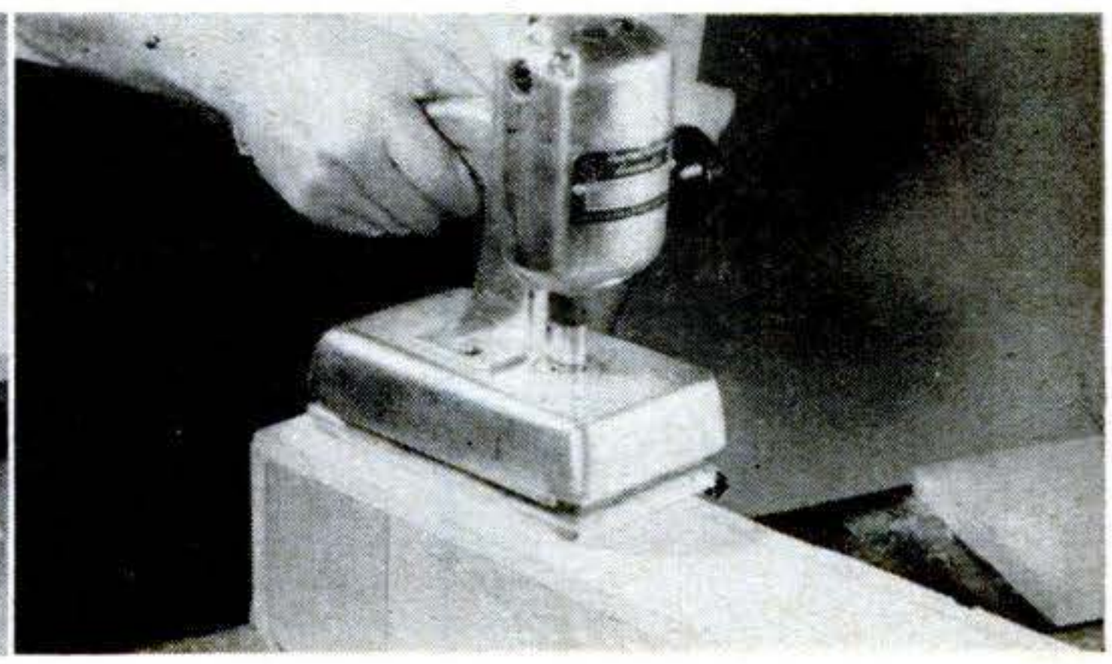


THE PLANE CUTS A FULL SIXTEENTH at maximum depth setting. Adjusting the front plate changes the depth of the cut. The 1¾" cutter will smooth the edge of a two-by-four piece. Bevels to 30° are possible with the plane.

DOVETAIL TEMPLATE was designed to work with the router. With it, mating dovetails can be cut simultaneously in two pieces in less than a minute. The pin and socket are cut with a single pass of the tool over both pieces.

THE ORBITAL SANDER smooths wood and levels plaster. Driven by the ⅜-hp. power head, this accessory is as rugged as a single-purpose sander. Pistol grip and side knob make the tool attachments easy to handle. END





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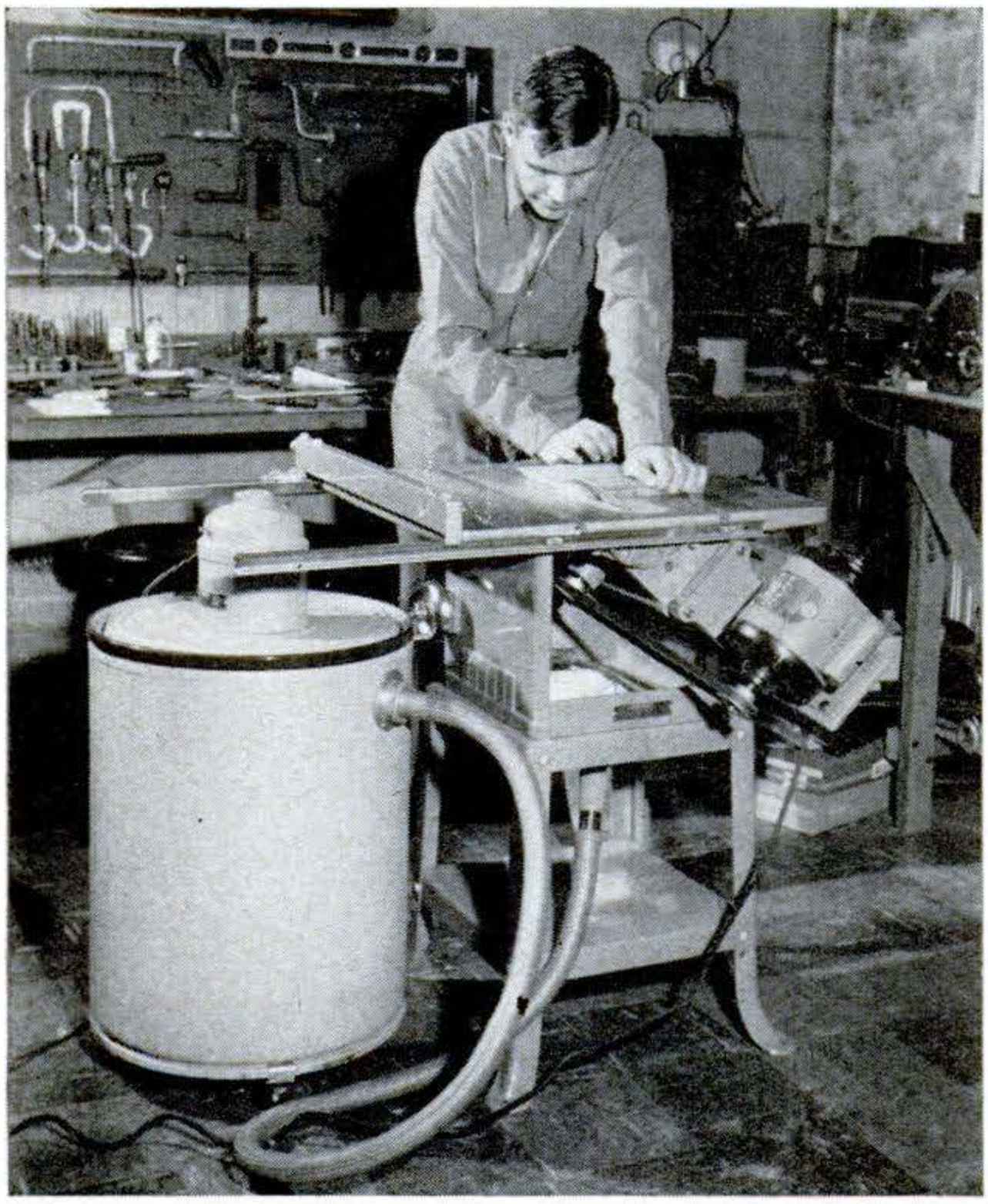
New Dust Collector Has Big Capacity



SPECIAL CANVAS DUST CATCHER fits inside table saw. Dust-collector hose attaches to fitting in catcher's center. Hose can be disconnected, without disturbing dust catcher, and used on other shop machines.

NEARLY three bushels of dust, chips and sawdust can be sucked into this big-capacity dust collector before it's time to empty the can.

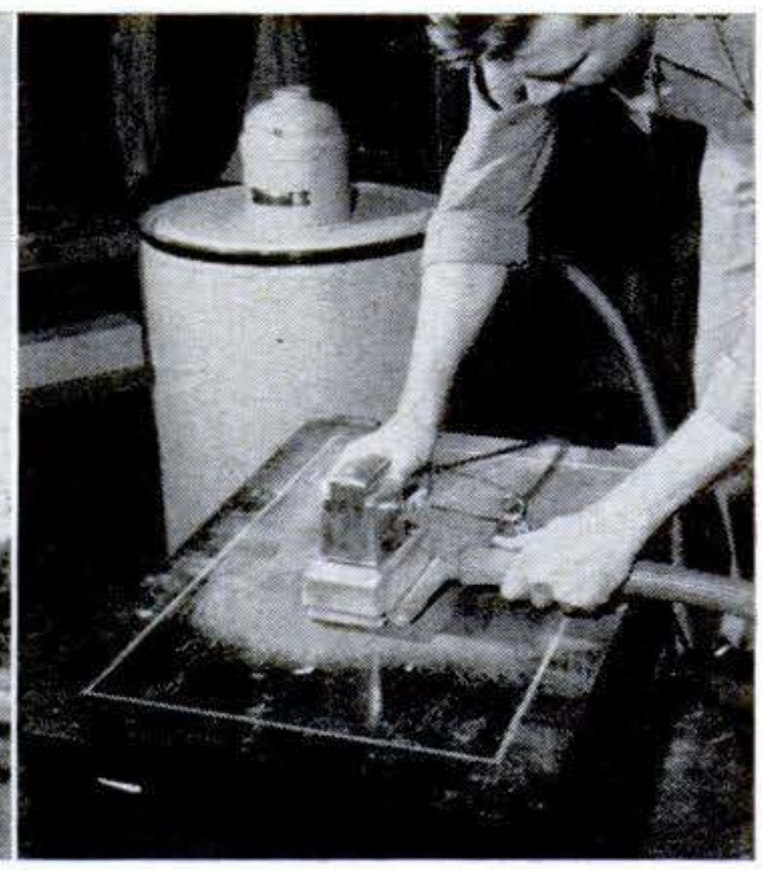
A ⅞-hp. motor pulls 60 cubic feet of air per minute through the unit. Special accessories permit attaching the pickup hose to shop machines to suck in dust at its source. The unit, made by Delta Power Tool Co., sells for $79.95.

Outside the shop it's a hungry vacuum cleaner that will do jobs you wouldn't try with a household vacuum. Dirt and chips do not contact the suction-fan blades, so the unit can pick up items that might damage or foul ordinary vacuums. Casters make it easy to move about.

By switching the hose from the intake to the exhaust fitting, the unit becomes a high-velocity warm-air dryer that speeds drying of glue or wet surfaces.

WARM-AIR DRYER is made by attaching hose to air exhaust at top of motor. In this position it blows clean, filtered air and can also be used with an attachment for spraying paint, liquid wax, insecticides and other liquids.

POWERFUL SUCTION pulls leaves and debris from gutters into long tube—no ladder needed. On a lawn where concentration of leaves is too light to be worth raking they can be sucked one by one into the tube.



SPRING CLAMP holds pickup unit close to source of dust when you use portable power tools. With same clamp, one of several pick-up attachments can be fastened to shop machines to catch dust and falling chips or filings.

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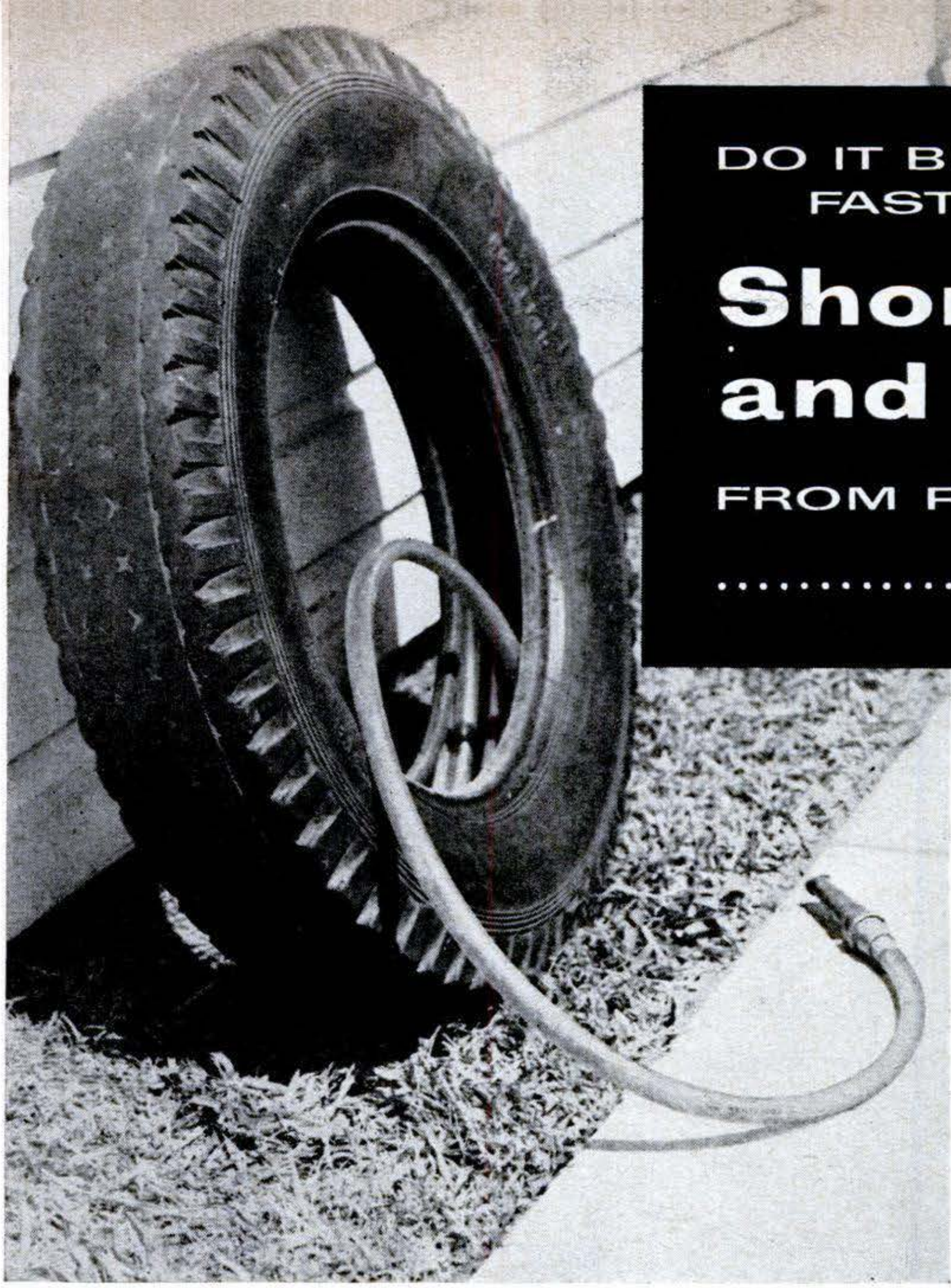
DO IT BETTER, FASTER, EASIER...

Short Cuts and Tips

FROM PS READERS

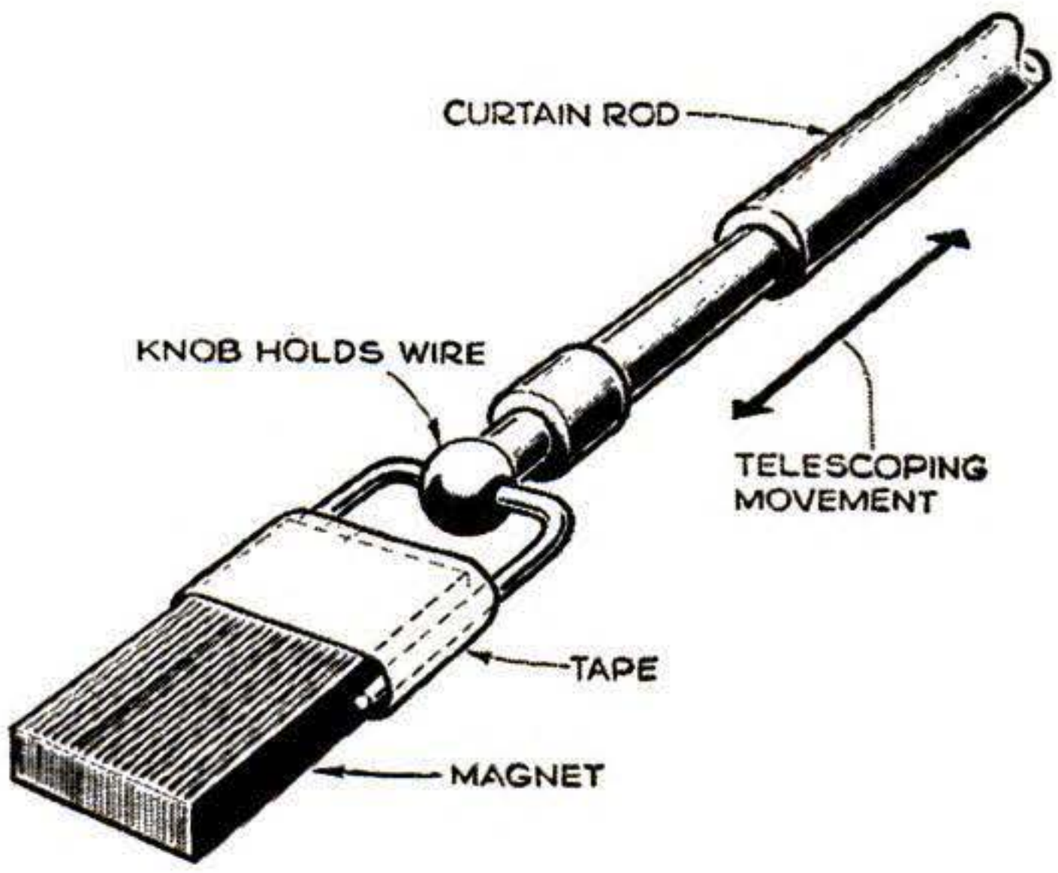


Hose Coiled in Tire for Storage

EVER think of storing the garden hose in an old tire? Make sure the hose is drained, then coil it full circle within the casing. The tire can be rested against a wall or laid flat on the joists in the garage or basement. —*Harold Jackson, Kankakee, Ill.*

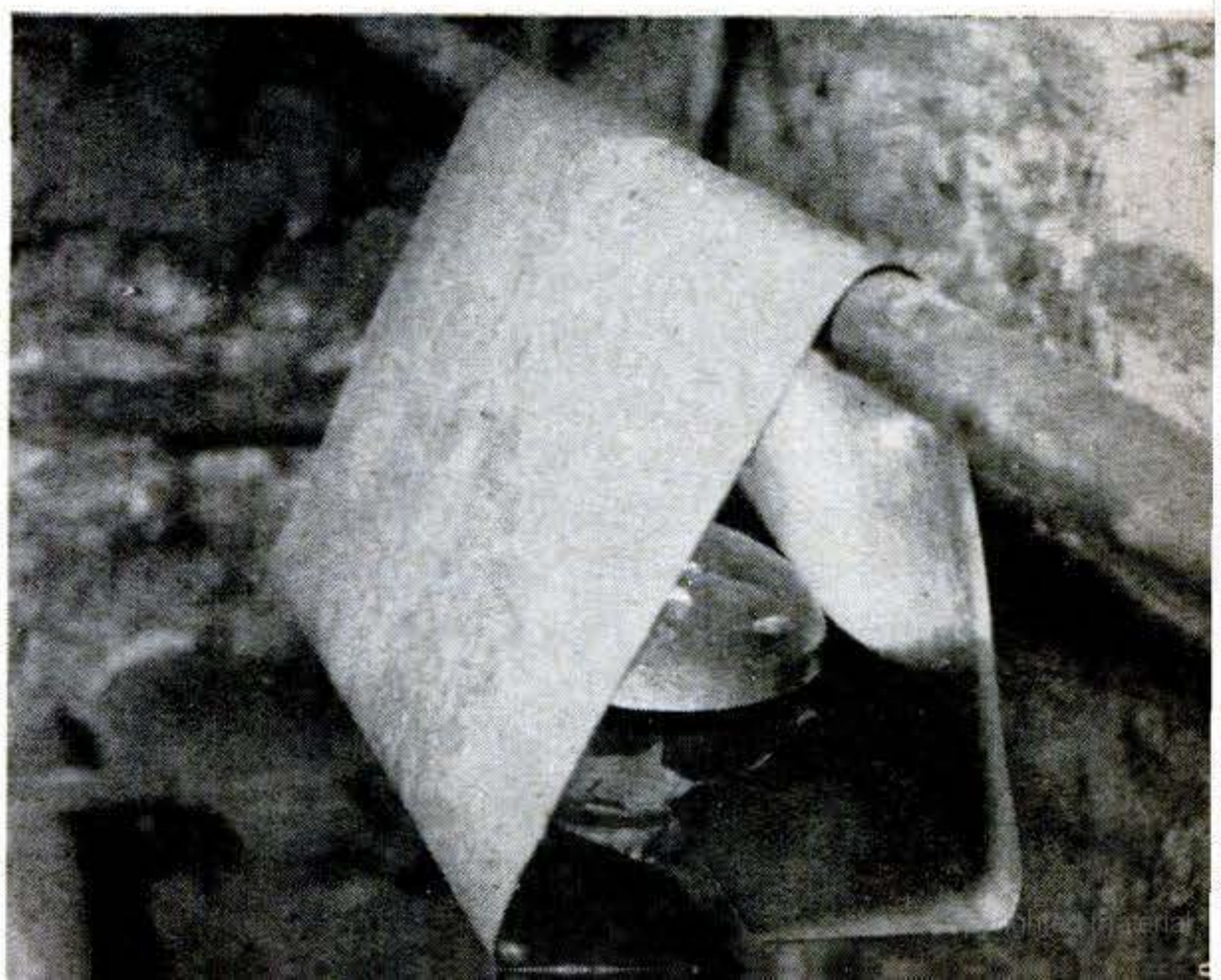
Magnet on Rod Aids Retrieving

A BAR magnet attached to the end of a telescoping curtain rod gives you a long reach for retrieving small steel parts that drop into hard-to-get-at corners. Slip a length of wire through the hole in one of the rod knobs, bend the wire U-shaped, and tape it to the magnet. Then squeeze the rod tube so that it holds at any length.—*Frank Shore, NYC.*



Hood Focuses Pipe Thawer

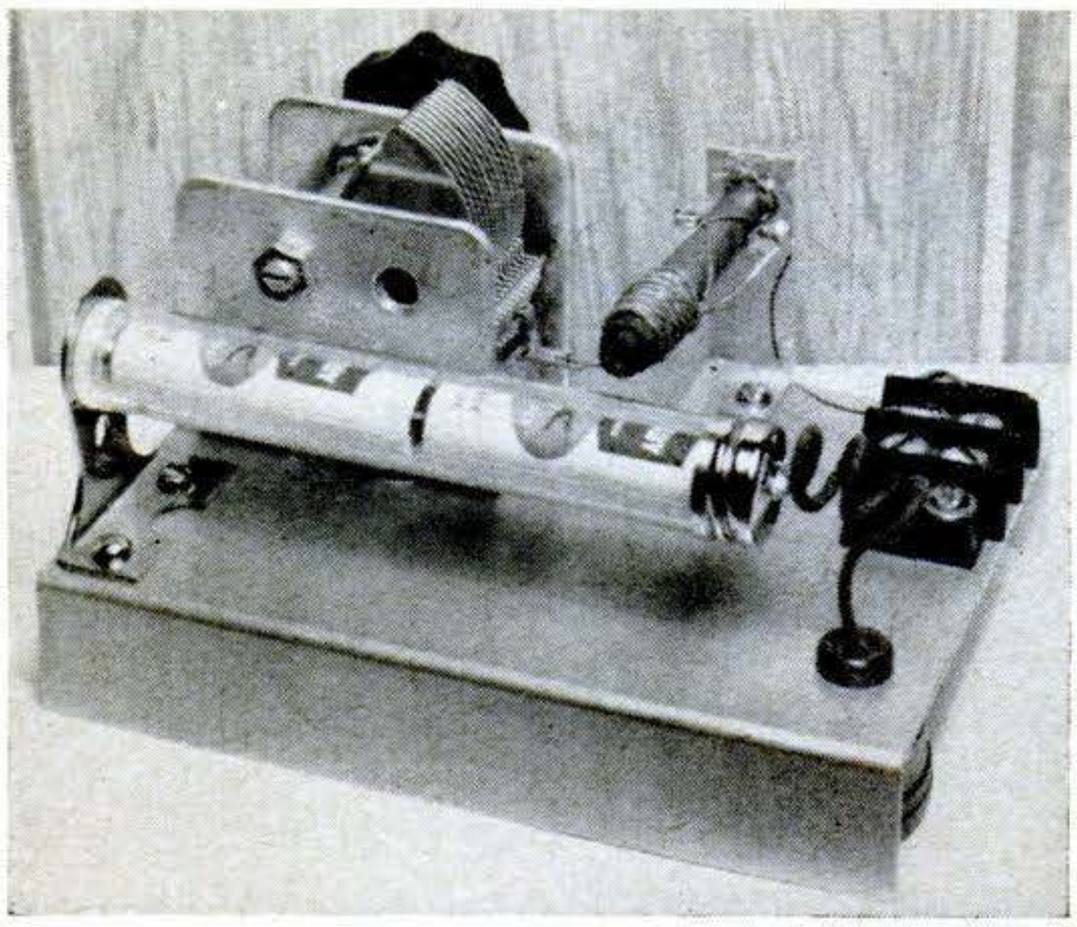
AN INFRARED bulb is an even better cure for frozen pipes if its heat is confined in a hood. Notch both ends of a strip of roofing tin and loop it over the pipe. Two bends make a flat base for the bulb and the neck is dropped through the meeting notches. For a deep freeze, work the thawer along the pipe several times.—*C. A. Phillips, Corning, N.Y.*

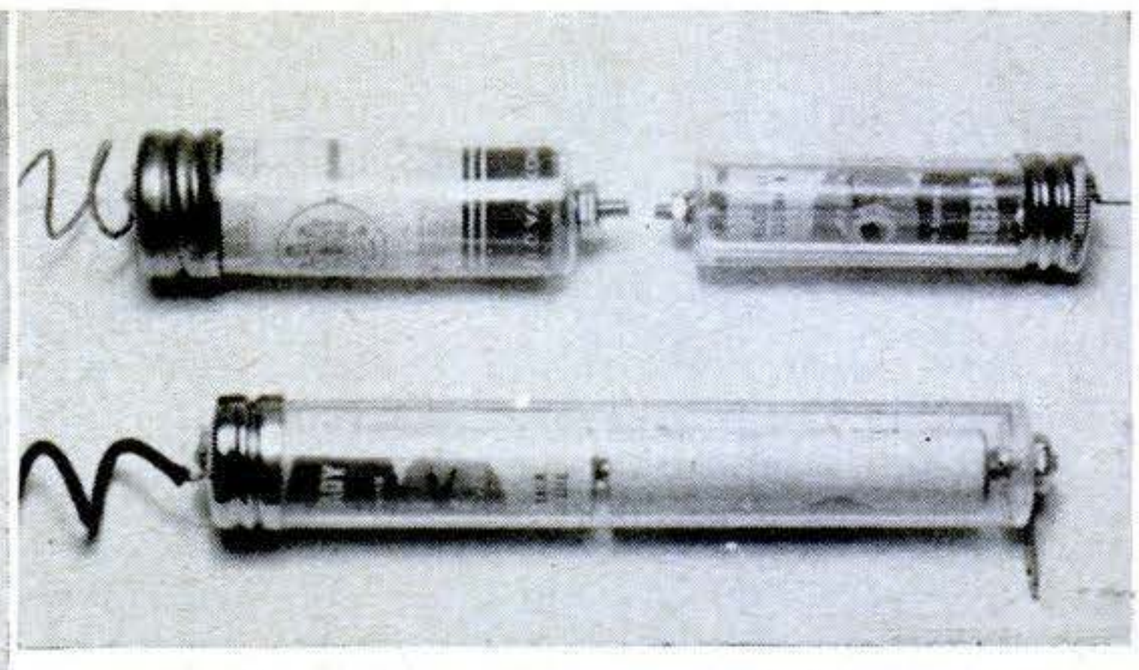


Short Cuts and Tips

Stiffener for Diaphragm Plugs Leak in Spray-Gun Compressor

IF A worn-out diaphragm is making your spray-gun compressor leak, you can make a quick repair with plastic imitation leather, inner tubing or even canvas. Remove the old diaphragm and cut an exact duplicate. Then put both together and replace them in the compressor. If the old one is in very bad shape, you may have to reinforce it with two new ones. *—L. C. Ferguson, Rio Linda, Calif.*





WINDOW-SHADE BRACKET (left) bolted to chassis supports container and grounds the batteries. In cases where power supply is insulated from chassis, use a plastic bracket. Make pigtail long enough to permit unscrewing cap.

Plastic Vial Used as Battery Holder in Small Electrical Setup

THOSE plastic containers used for packaging many dime-store items are fine holders (above right) for small batteries in transistor sets, models and electric toys.

They simplify changing batteries—unscrew the cap and pour them out. If you allow exhausted batteries to stand, vials prevent leakage and acid damage.

Fasten roundhead machine screws in the bottoms of containers to make contact with the metal ends of the batteries. Then solder a pigtail lead to metal caps to continue the circuit. If the caps are plastic, fit them with roundhead screws.

▶▶▶ A CLAY pipe buried on end is a good root cellar. Choose pipe wide enough to take a bushel basket and its contents. Cast a lid from cement. In most areas an 8″ layer of straw will prevent freezing.

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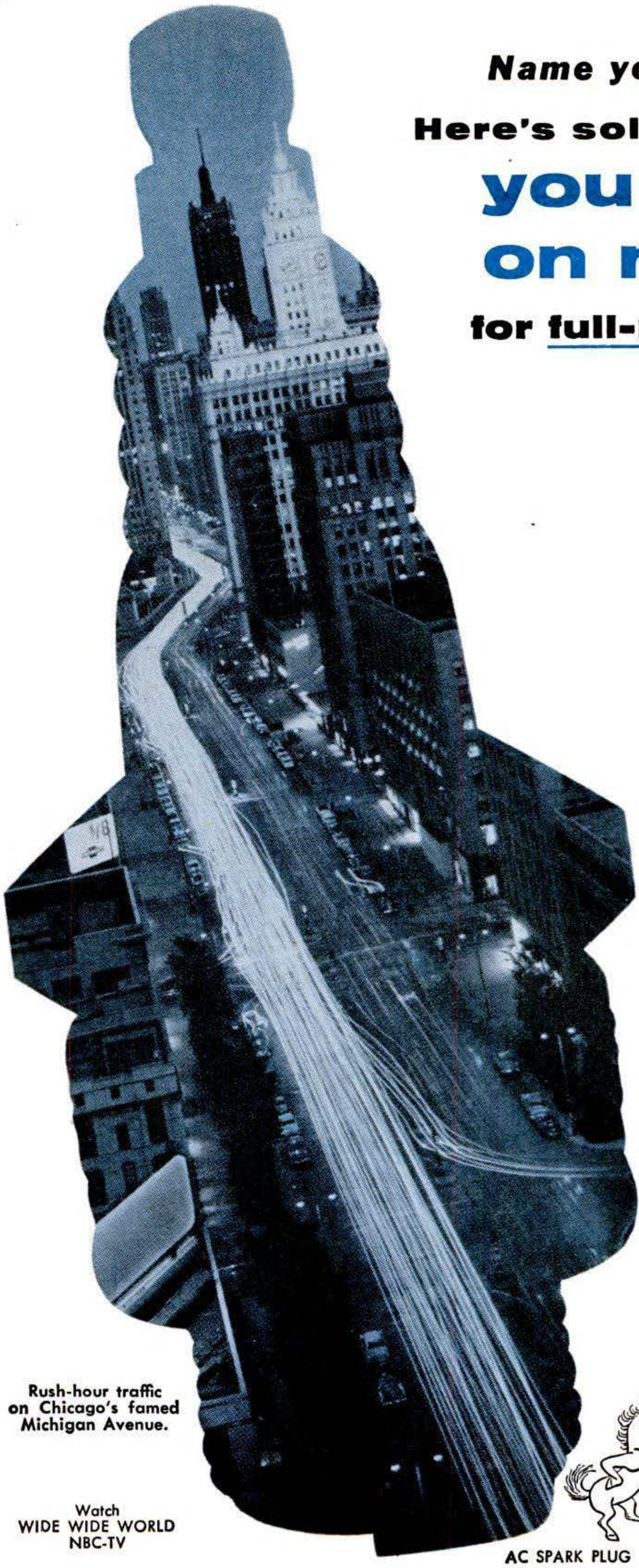

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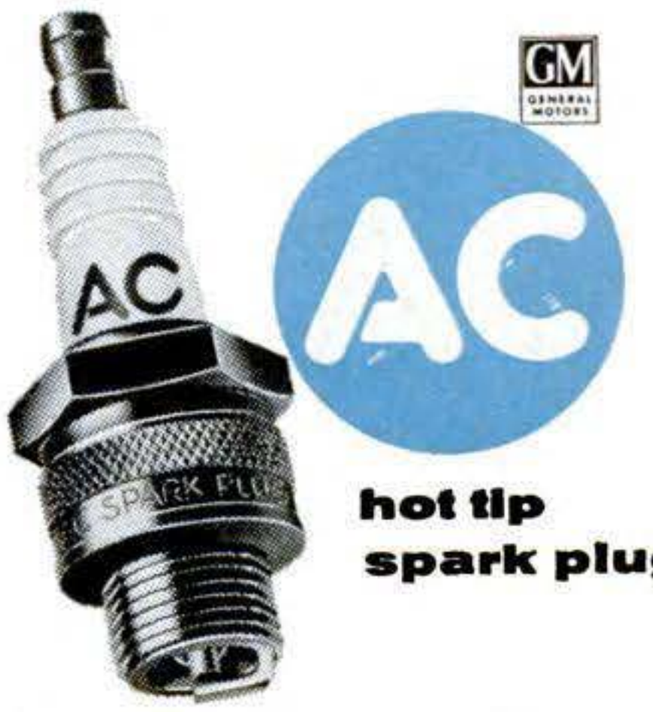

hot tip spark plugs

NOTE: For most efficient operation, change spark plugs at least every 10,000 miles.

AC SPARK PLUG THE ELECTRONICS DIVISION OF GENERAL MOTORS

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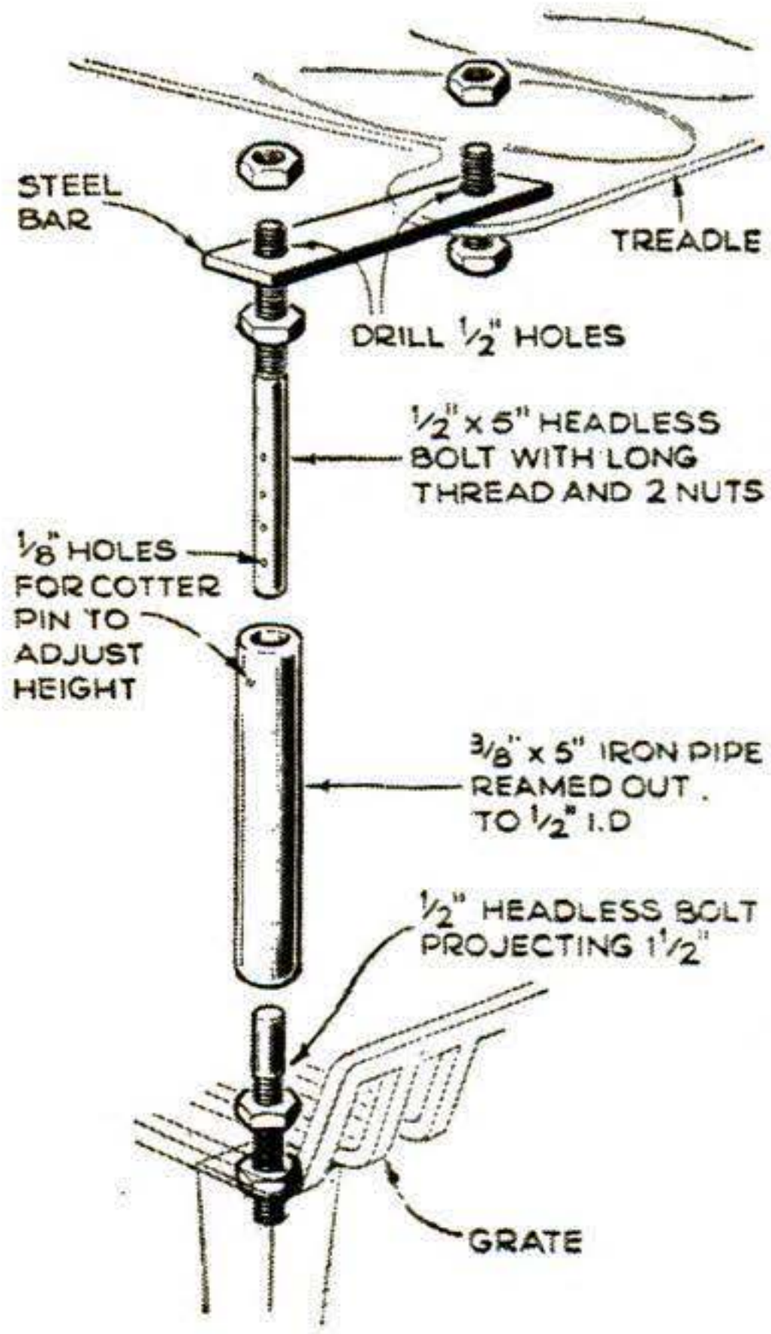
Short Cuts and Tips

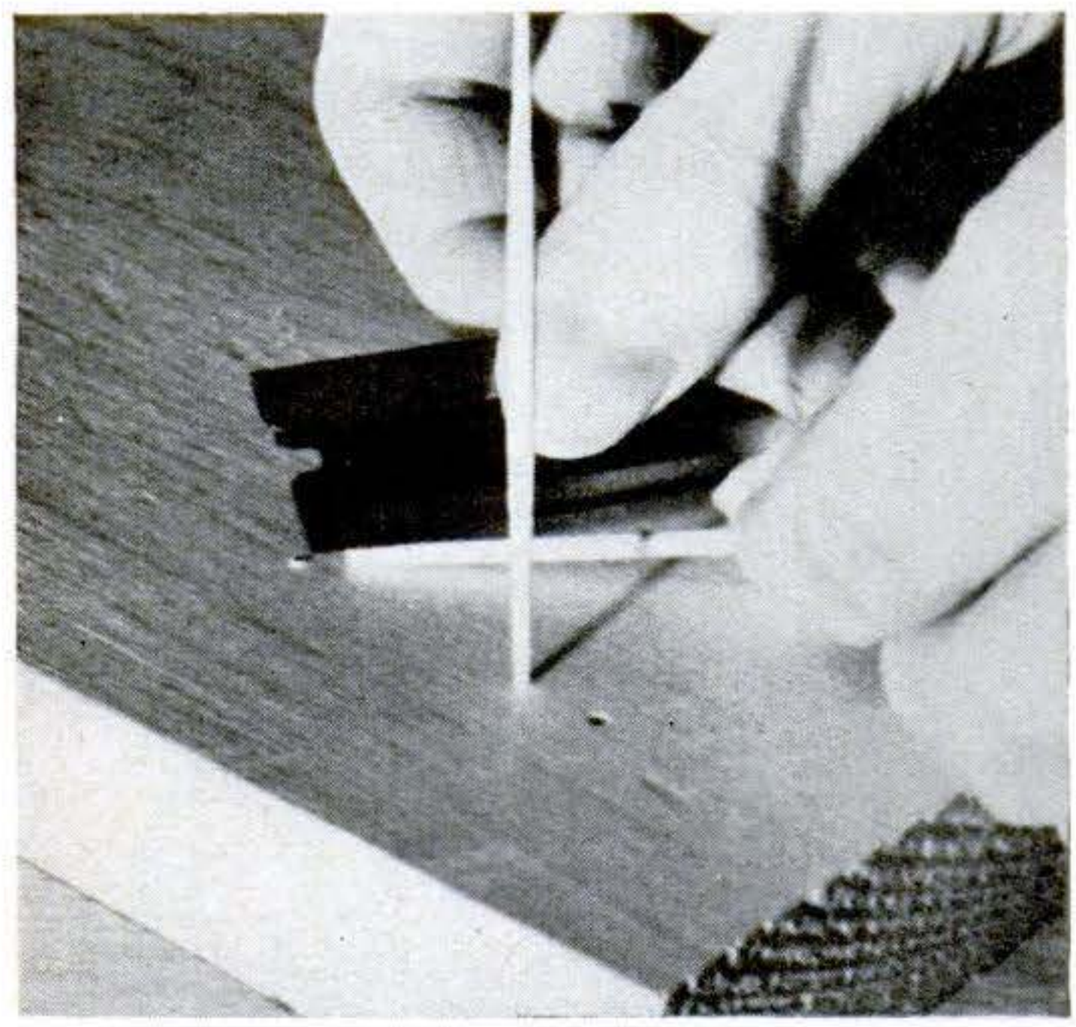


Treadle Used as Indoor Cooking Grill

AN OLD sewing-machine treadle made a husky grill for use over my fireplace grate.

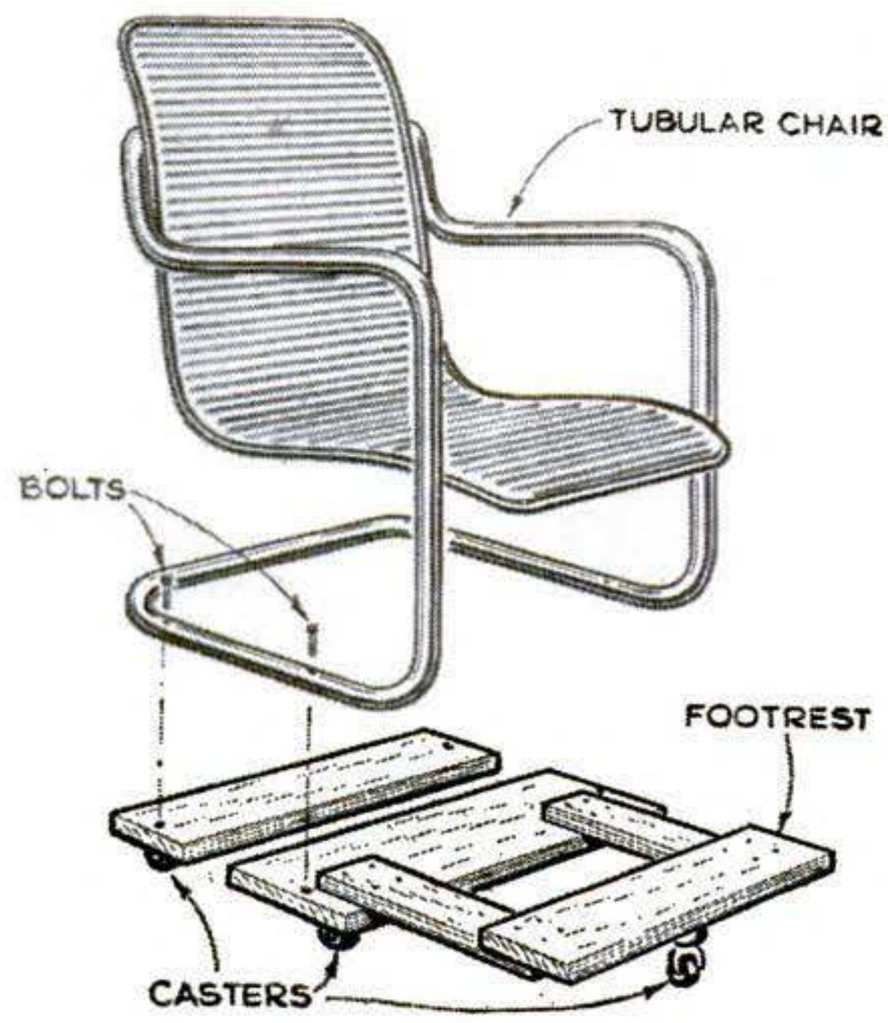
I replaced one leg bolt of the grate with a headless stud and slipped a pipe over the projecting end. A second stud dropped into the pipe was fastened to a swinging steel bar which was also end-bolted to one corner of the treadle.

The grill swings outward for turning meat, and lifts out of the pipe for cleaning. A sheet-metal pan, punched with holes, lines the grate to hold the coals in place.—*A. D. Beck, Arlington, Va.*



Toothpicks Plug Up Tiny Holes

THUMBTACK holes in a drawing board, brad marks in salvaged lumber and other tiny holes in wood can be plugged with smooth, round toothpicks. Dip the end of the toothpick in glue, force it into the hole and trim it flush with a razor. Sand the area smooth.—*Frank A. Javor, Newark, N.J.*



It's a Temporary Wheel Chair

A TUBULAR chair can be turned into a temporary wheel chair. Drill holes through the base, bolt on boards and mount furniture casters. A fifth caster on a nailed-on footrest will keep the chair from tipping forward as the patient is eased into it.—*J. D. Follett, Warrenton, Va.*

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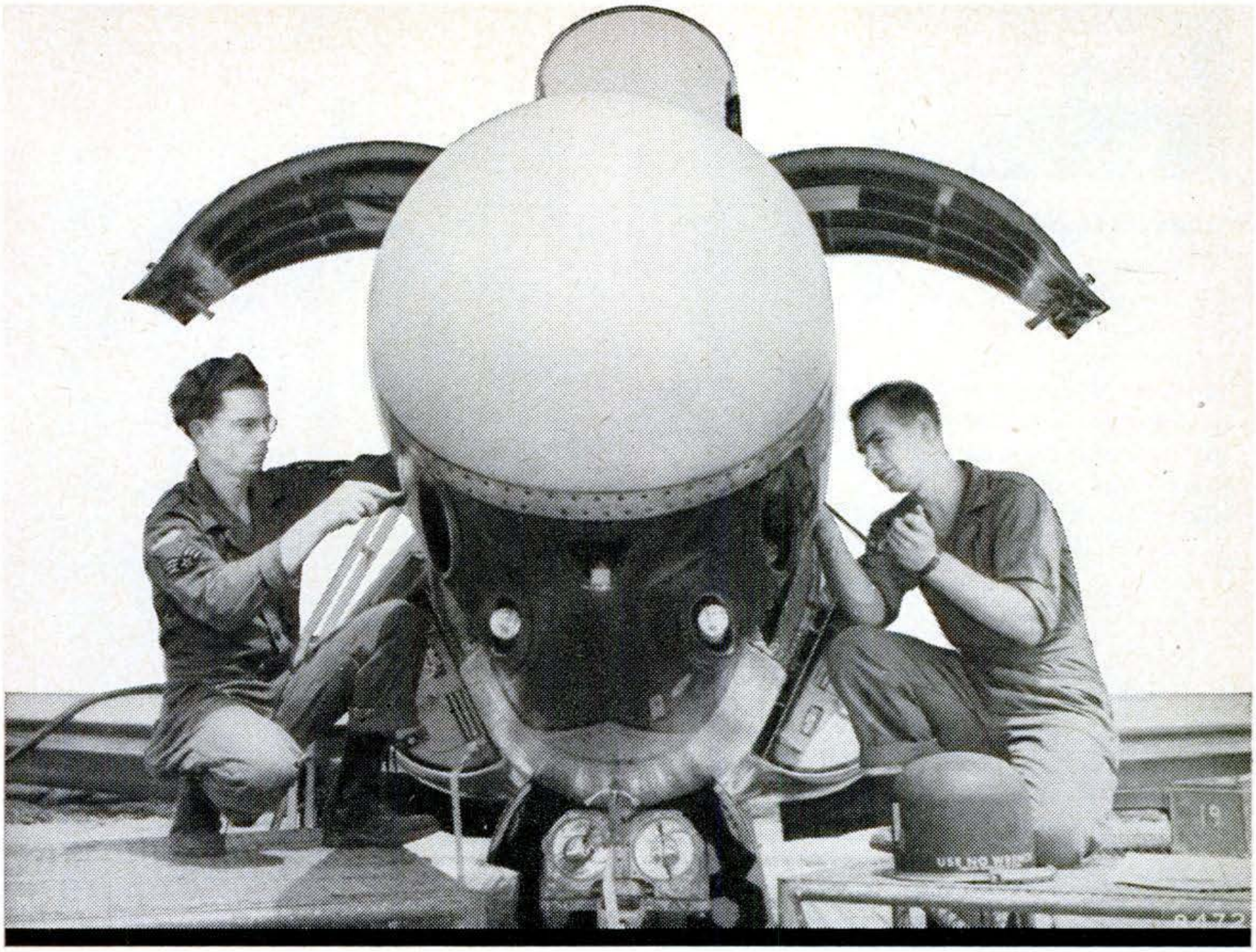

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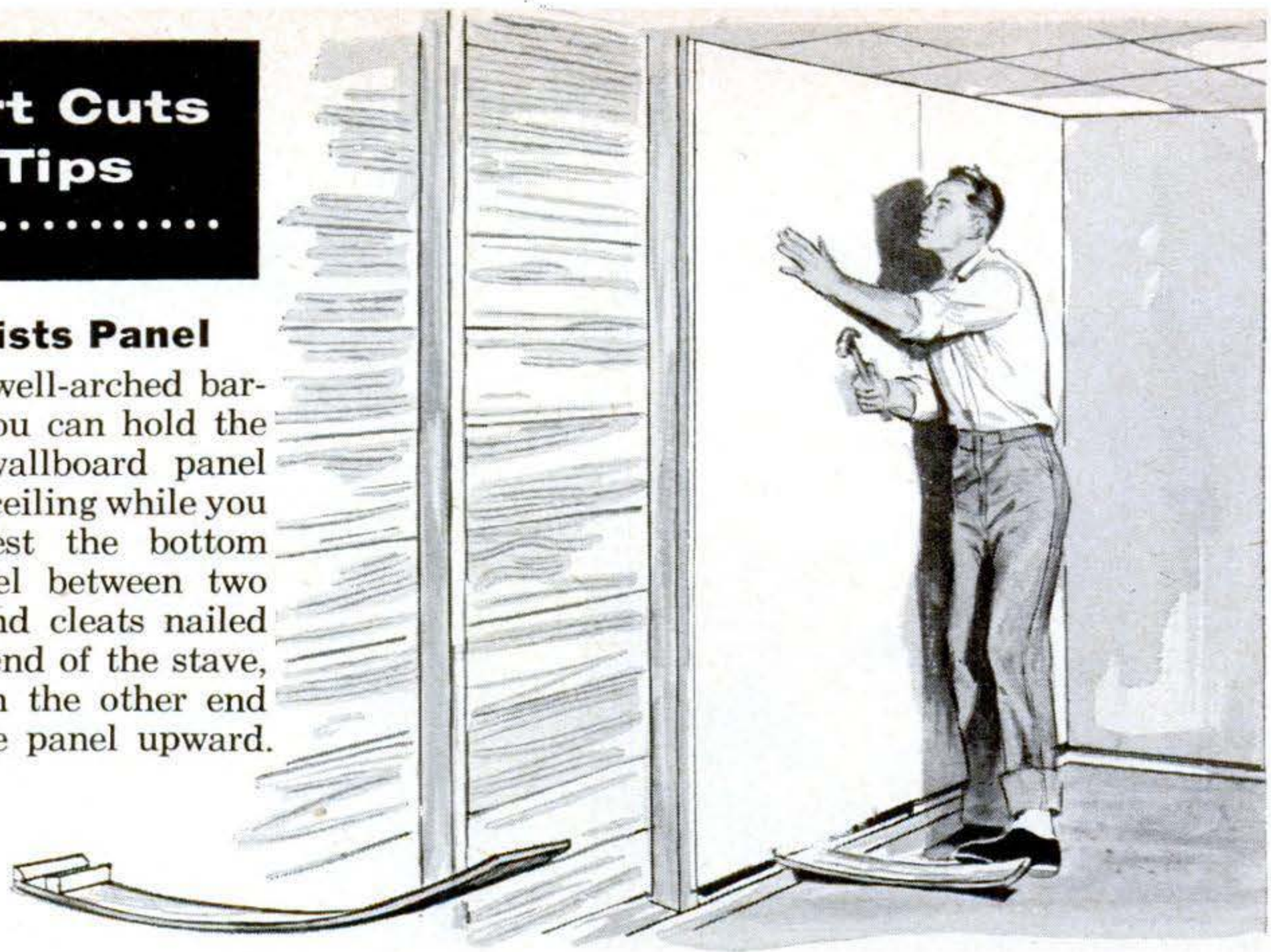
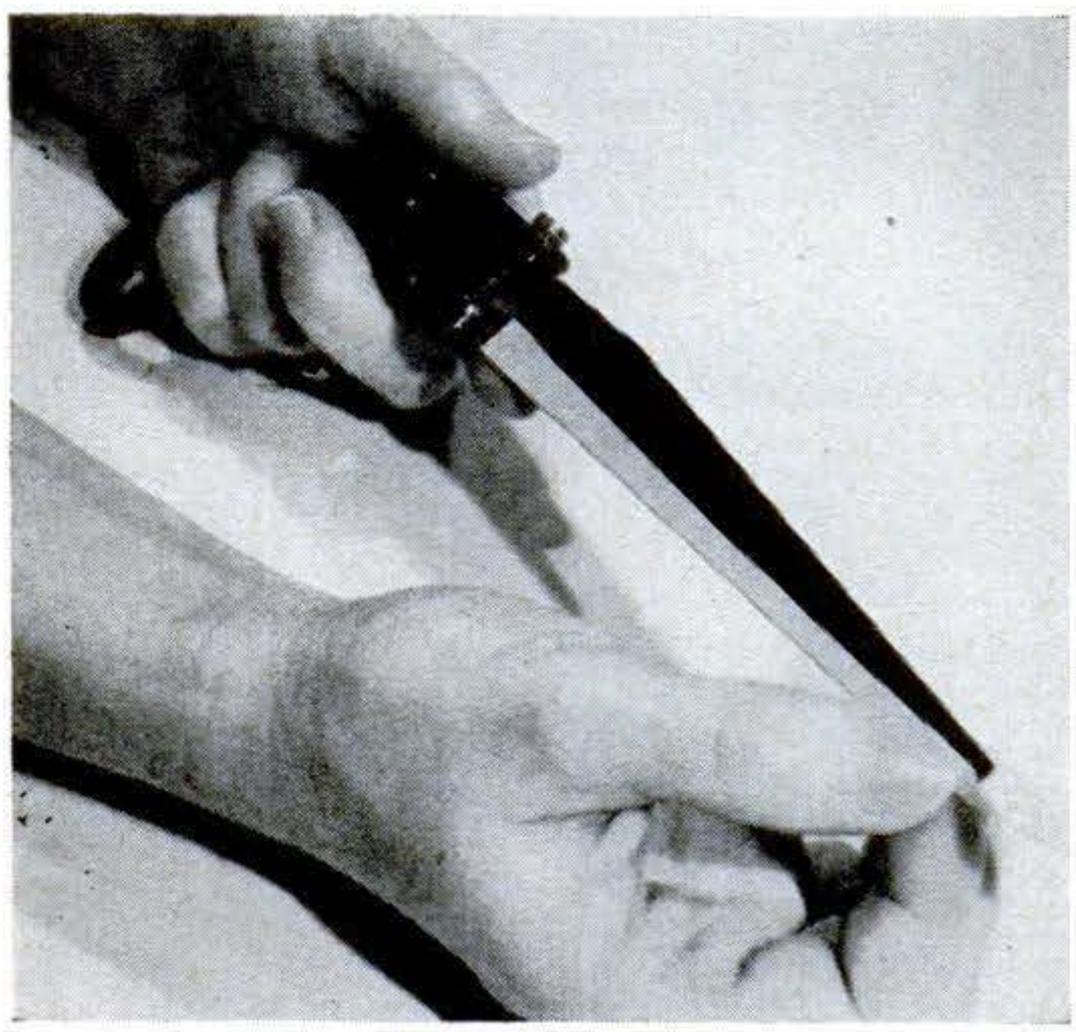
Short Cuts and Tips

Stave Hoists Panel

USING a well-arched barrel stave, you can hold the top of a wallboard panel against the ceiling while you nail it. Rest the bottom of the panel between two quarter-round cleats nailed across one end of the stave, and step on the other end to lever the panel upward.

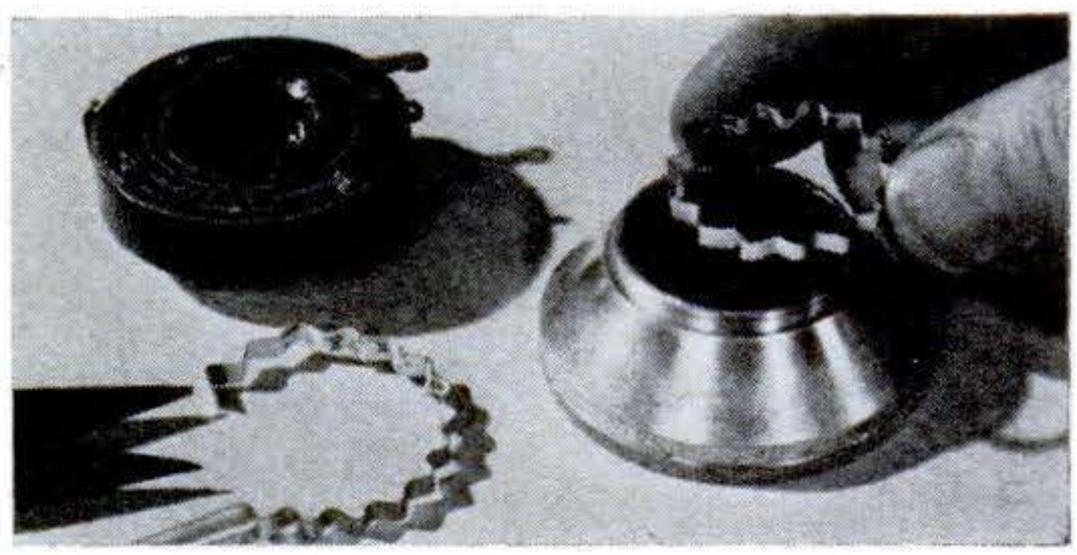




Tape Sheathes Saw Teeth

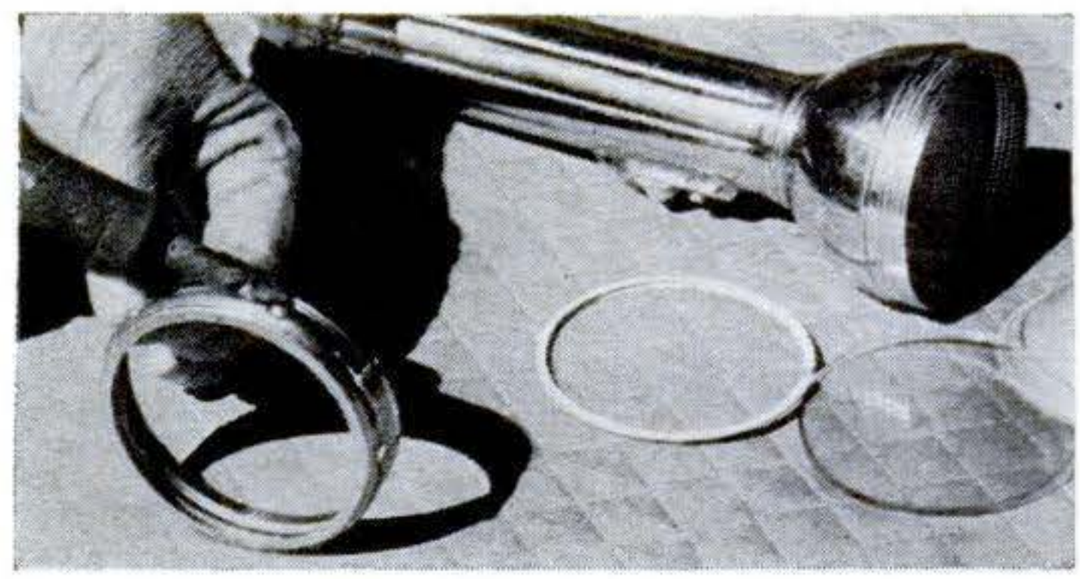
THE teeth of a small saw won't be damaged, or do damage, if you cover the cutting edge with masking tape. This is good protection for saws carried in a portable tool case, where there is constant rubbing.—*Frank A. Javor, Newark, N. J.*

▶▶▶WHEN a screw won't hold because the hole has gotten too big and I have to use the same size screw, I solve the problem by jamming a bit of steel wool into the hole. Then I turn up the screw and usually find that it holds securely again.—*H. W. Swope, Danville, Pa.*



Tin Can Adapts Lens Shade

A LENS shade that is too big can be made to fit a lens by using this reducer ring. Cut a narrow strip from a tin can and crimp with needle-nose pliers. Shape, cut off excess, and drop it in the shade.



Solder Stops Rolling Flashlight

EVER wish for a square flashlight case? The one you have won't roll if you sand the lens ring at six equidistant spots and drop a blob of solder at each point.—*Clinton R. Hull, Santa Ana, Calif.*

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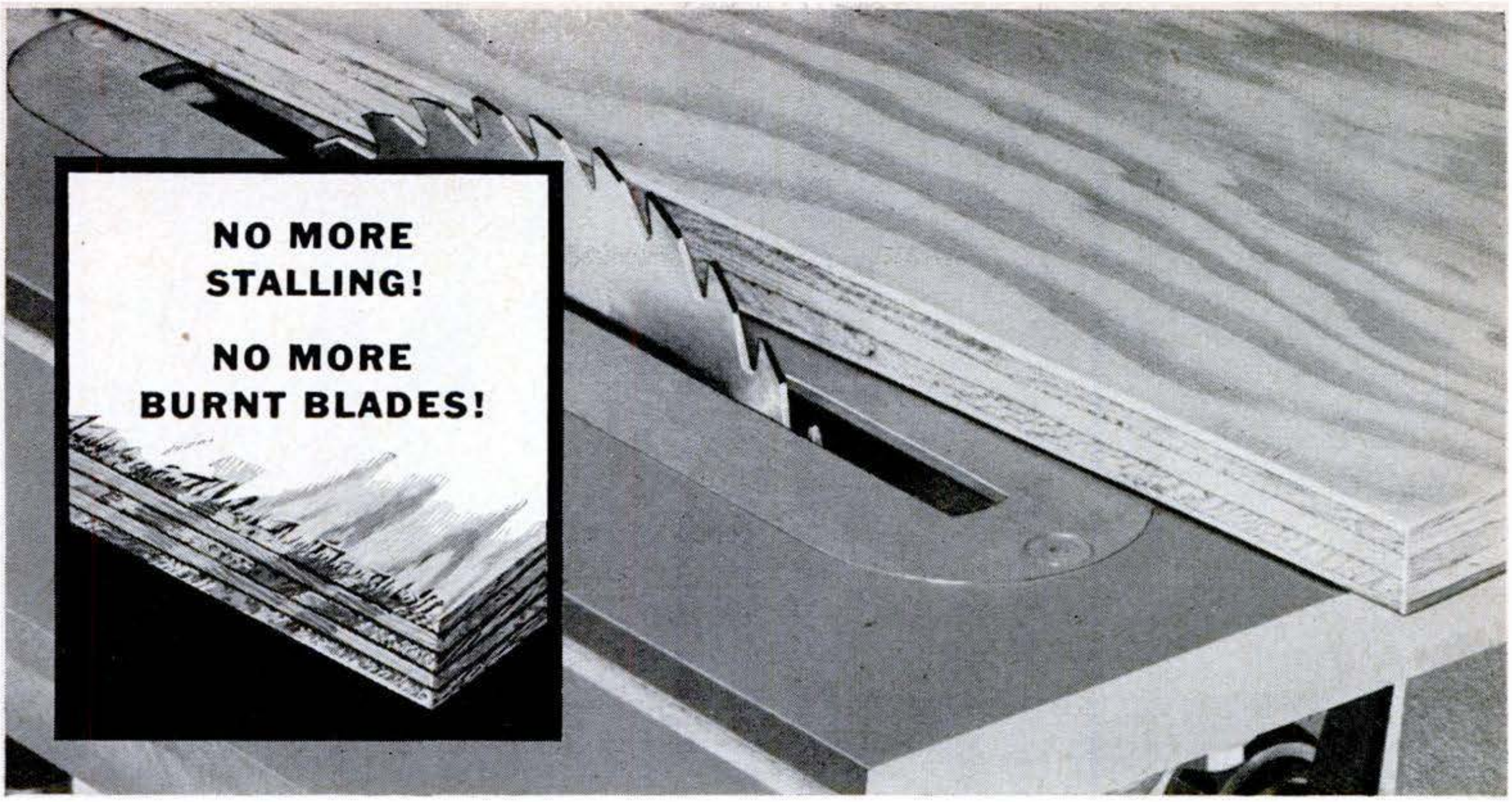

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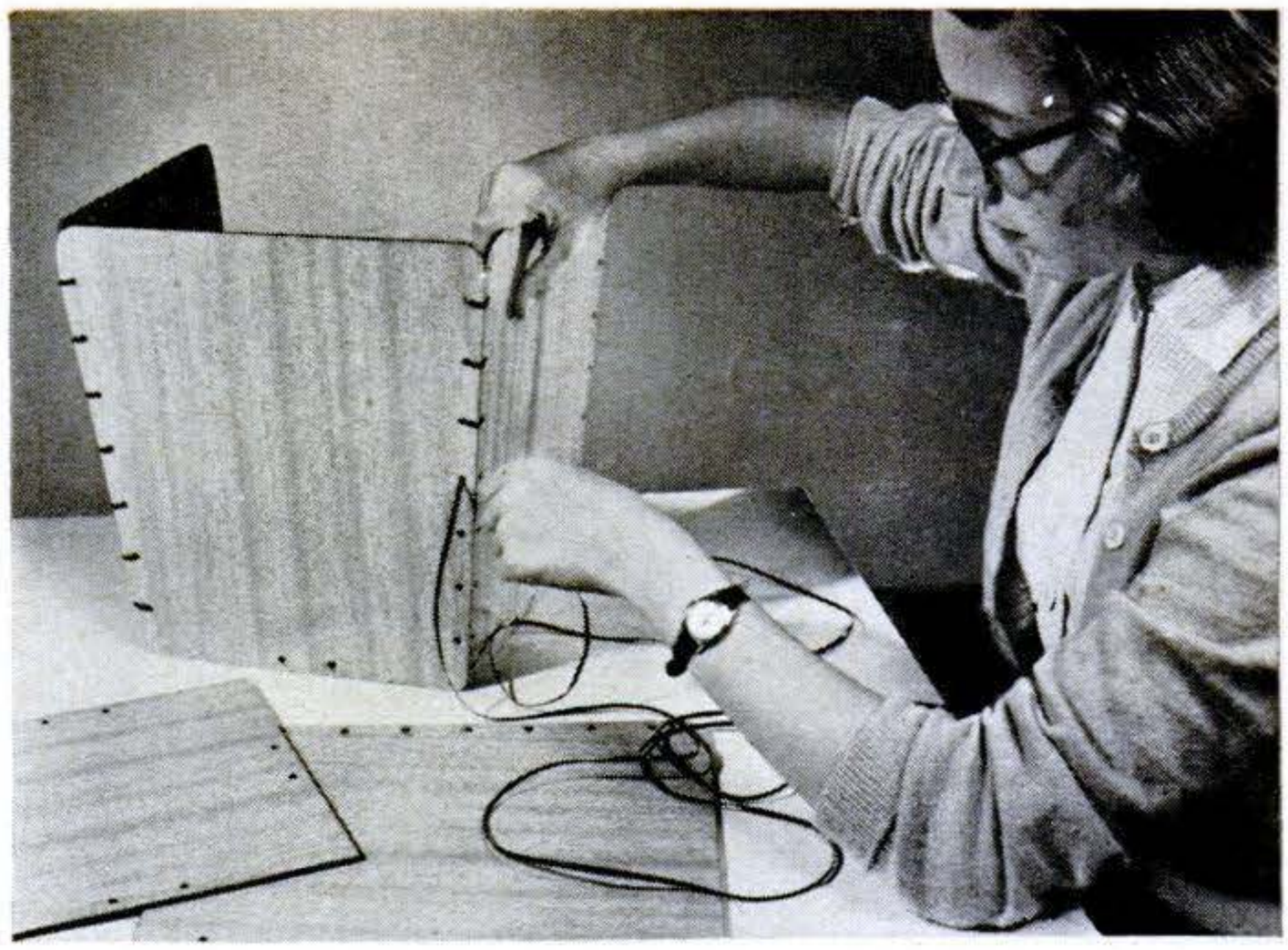
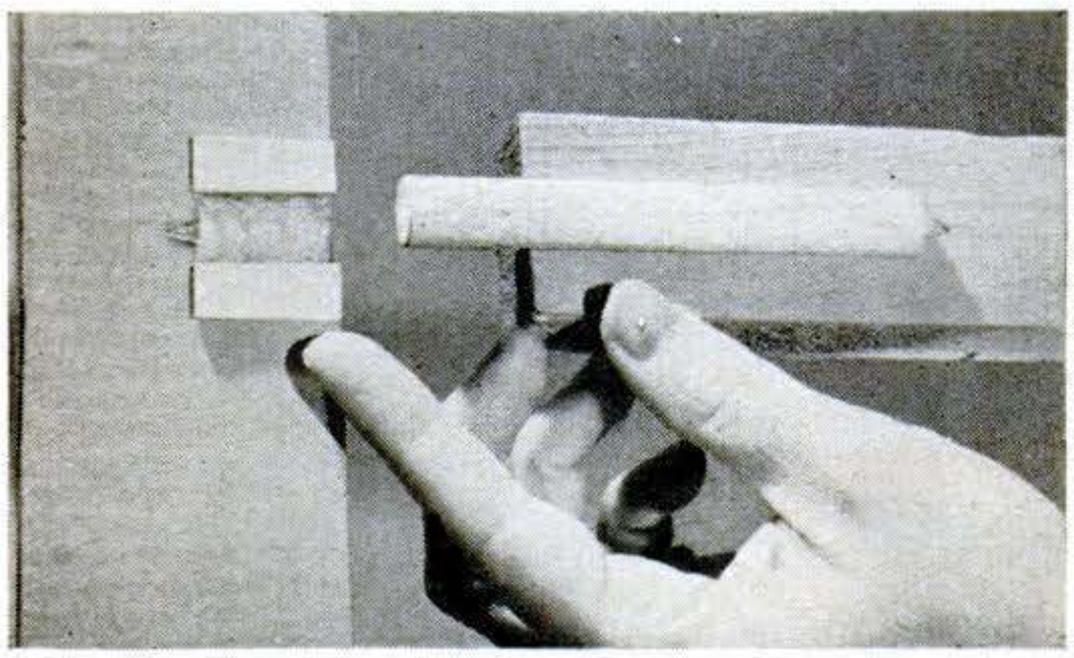
Short Cuts and Tips

Panels Form Basket

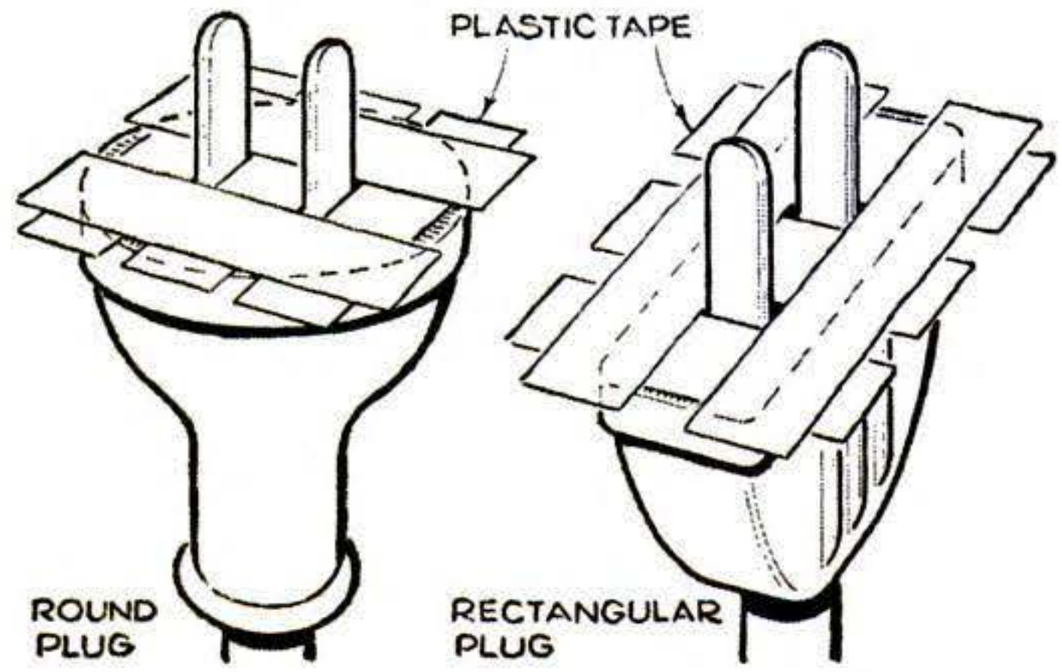
A WASTEBASKET to match the room paneling can be made from leftovers of prefinished hardboard. Cut four tapered sides and a square for the bottom, drill them with matching edge holes and lash them together with plastic or leather laces.





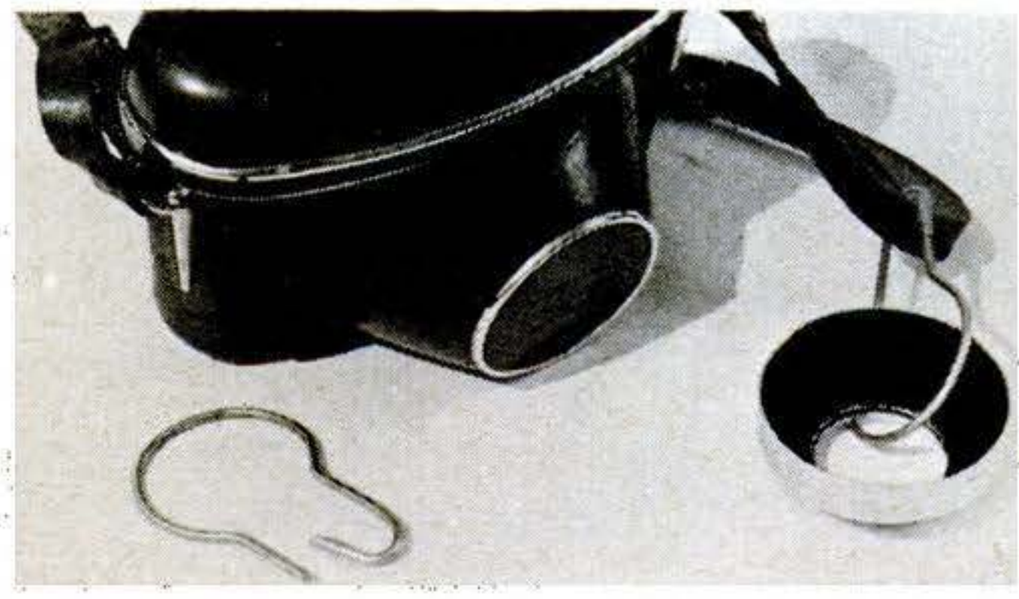
Dowel Replaces Broken Tenon

A CHAIR rung that breaks off at the tenon can be salvaged and repaired as shown in the cutaway mockup above. Saw off the broken tenon cleanly and bore a socket in the leg to take a larger-sized wood bushing, as at the left. Bore out rung and bushing for a long dowel. Glue all parts and clamp them together.



Tape Protects Electric Plug

PLUGS on appliance cords should be checked now and then for exposed wires. If the cardboard seal is torn or missing, crisscross the open end of the plug with plastic tape as shown. Trim off excess tape, or fold it down and secure it by taping a strip around the base of the plug. —*Hugh F. Williamson, Butte, Mont.*



Snap-On Hook Holds Lens Shade

TO KEEP my lens shade handy and safe from loss when it's not in use, I string it on a metal shower-curtain hook which I can always keep clipped to the strap of my camera carrying case.—*Warner G. Tilsher, South San Gabriel, Calif.*

Oven-Dried Dowels Fit Tighter

WHEN you're working with dowels, it's good practice to heat them beforehand in a low to medium-warm oven to drive out moisture. Later on, when the wood reabsorbs moisture from the air and expands, you'll get a much firmer joint.

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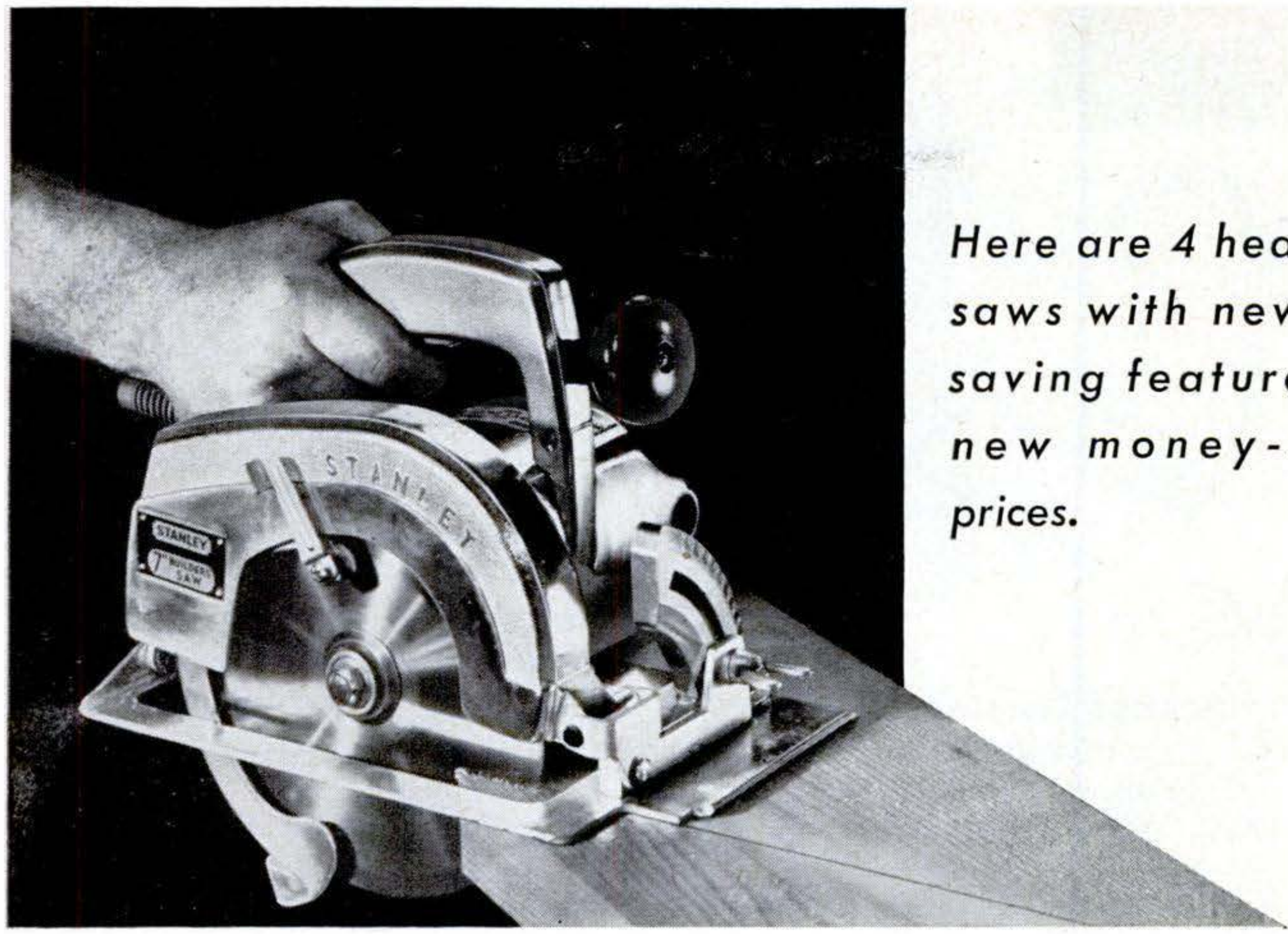
New Saws at Low Prices!



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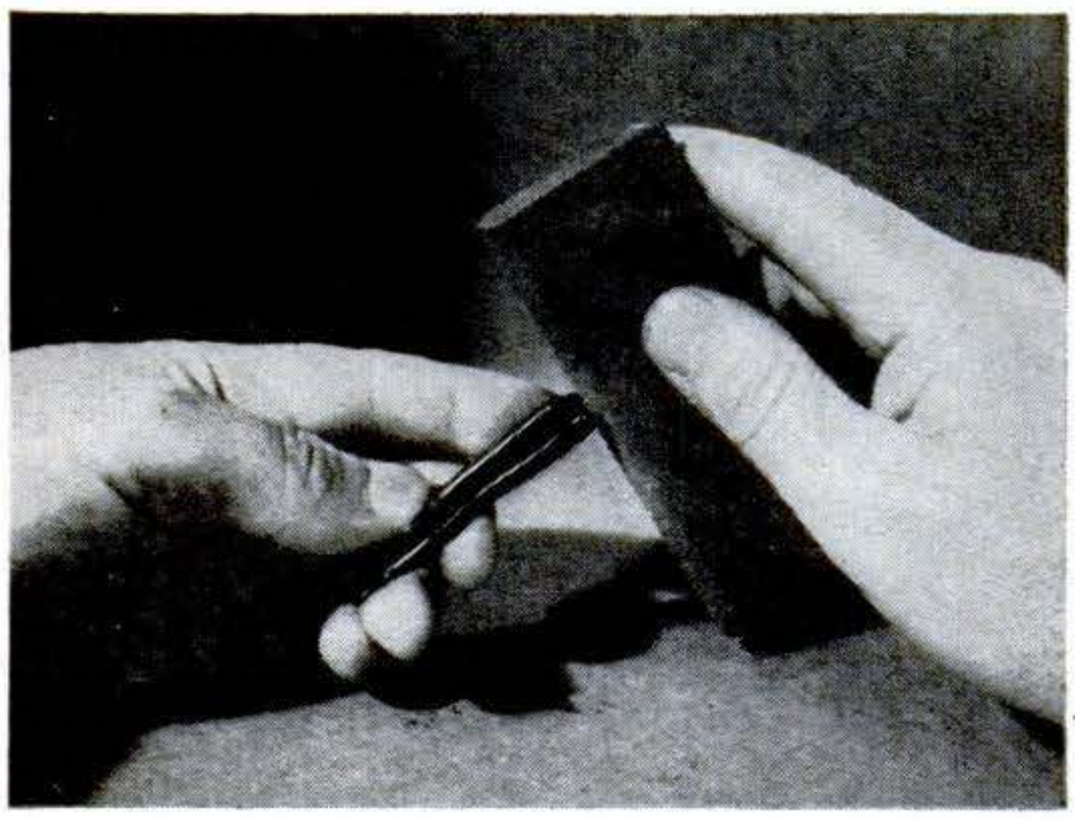
Short Cuts and Tips

Old Ball Pen Makes Tracing Tool

DON'T throw away that old ball-point pen. Its dryness is an advantage if you use it for tracing over carbon paper. It glides over the original without visibly marring it.—*Frank Shore, NYC.*



Stone Hones Nail-Clipper Jaws

DULL nail clippers can be sharpened by drawing the cutting edges across the curved edge of a slip stone. Hold the clipper jaws closed while sharpening to keep them even. A few passes remove the old surface.—*Ken Murray, Colon, Mich.*

▶▶▶A BALL of rubber cement will clean typewriter keys. Drop a fair-sized gob of it on paper and, after the thinner has been allowed to evaporate, roll it into a ball. As you press or rub it on the keys, it picks up ink and eraser particles which can be kneaded toward the inside so the ball can be re-used.

Why TV Parts Sometimes Burn Up

[Continued from page 196]

it was burning. On the bench I turned it on. Sparks and heavy smoke poured from the low-voltage transformer. The primary windings had shorted through to the secondary. I replaced the transformer, thinking that this would do it. Then, following routine before I turned on the set again, I checked the rectifier tube. It was defective, too. The cathode had shorted to its anode, causing the transformer to draw too much current.

I installed a new rectifier tube, certain I had it this time. As a last check, I took an ohmmeter reading between B-plus and chassis ground. Sure enough, the worst was present. Only a few hundred ohms off a dead short! The rectifier tube wasn't the cause—it was the victim.

Checking down the B-plus line with my ohmmeter I found the lowest resistance in the damper circuit, which is also the B-plus boost circuit. Some of the anodes require more B-plus than the power supply can give. That's where the B-plus boost comes in.

Primarily the damper's duty is to eliminate unwanted oscillations produced in the horizontal sweep action. Since the oscillations are an AC voltage, the dampening consists of rectifying or turning this AC into DC. It turns out this DC is about 450 volts. So rather than let it go to waste, the 450 volts DC is filtered and added to normal B-plus. As a boost, it gives an extra hundred-or-so volts.

I found that the damper tube was the original source of all the trouble. It had a heater-to-cathode short. This was throwing an undue drain on the low-voltage rectifier. Under the load, the old rectifier had shorted and caused the transformer to burn up.

After I completed installing the chassis, the set owner came over and started to talk credit terms with me since the repair bill was rather high. Lea settled the bill, but I didn't get a cent. If anyone needs me on Wednesday nights, they'll find me throwing my body around 1209 High Street. You see, it was a cha-cha dancing class. END

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[*Continued from page 174*]

wrong. He stooped down and in the wink of an eye he had set it to rights. He looked up to see if Lister had noticed, but the boy was intent upon making change at the register.

AFTER Mrs. Chambers left, Gus filled his pipe, lighted it and sat down on an oil drum. "Come over here, boy," he called to Lister. "I want to talk to you."

"I'm busy right now, Unk," Lister replied. "I'll—"

An unaccustomed glint came into Gus's eyes. Almost to his own surprise he heard himself roar, "Come here!"

Lister came

"She's not going to call," Gus told the boy evenly.

Lister flushed, caught off guard, looked at the phone and then back at his uncle. "Wh-what do you mean?" he stammered.

"I mean your little rescue act is off. Mrs. Chambers is not going to stall half a mile down the road."

"B-but I never—"

"Oh, yes you did. You counted on her doing that because you stuffed a wad of cotton waste in her exhaust pipe."

"Why would I do that?"

"I'll tell you why!" Gus was having a difficult time keeping his temper under control. "You knew that if the exhaust pipe was blocked off, the exhaust gases would back up and cause the motor to overheat. Then you would hop to her rescue and play boy genius again. But it didn't work. I saw the wad of waste there and pulled it out."

Lister was combing his hair nervously.

"Stop that!" Gus exploded. The defiance began to seep out of the boy. His hands hung limply at his side. It was as though he were skewered on the point of his uncle's anger. "Furthermore," Gus continued angrily, "I know what you did to Billy Wells' car. You took off the terminal nut that holds the hot wire on the ammeter, so the wire hung by a hair. That made the ignition cut in and out. When the lug fell off the terminal, the engine wouldn't start. I called and asked him where you had worked."

Gus got up and paced the length of the garage. At the far end he turned. His voice was a little softer, but still stern. "You know something, boy? I think you would make a good mechanic. You know a lot more about engines than I gave you credit for. But I don't understand why you want to use your knowledge to make trouble. Why, Lister?"

"Uncle Gus..." The boy struggled for words, but they wouldn't come. He turned and ran for his jalopy. He took off slowly —without the usual dash.

Stan Hicks pulled himself slowly out from under a pickup truck. "Why that sniveling sneak," he exclaimed. "Good thing you caught on to him when you did. He might have ruined your business. Well, I guess we've seen the last of him."

"Guess so," muttered Gus. All traces of anger were gone. "I wish I could have done something for the kid."

The afternoon dragged on. Gus went about his work listlessly. At closing time, as he was locking up the Model Garage, Stan called, "Look who's coming back." Gus turned just as Lister drove up.

The boy got out and walked up to Gus. "I know you're mad at me," he began hesitantly. "I don't blame you. But I couldn't leave without—well, without saying good-by."

"Good-by," Gus said awkwardly.

"I want to tell you something," Lister continued doggedly. "You said something to me this afternoon that I'll always remember. I don't mean the chewing out. I had that coming. But you said I was a good mechanic. You know, Uncle Gus, that's the first time a grownup has told me I was good for anything since my father died." He stuck out his hand shyly. "Thanks, Uncle Gus."

Gus took the boy's hand. "Do you mean that, Lister?"

"I sure do, Uncle Gus. It means a lot if *you* think I'm a good mechanic."

GUS cleared his throat. "Say, Stan Hicks is due for a vacation next week. Would you like to take over for him?"

"Do you mean it?" Lister's face lit up like a beacon.

"What do you say, Stan?" Gus asked.

"Okay by me."

"Just one thing, Lister," Gus said. "You'll have to get that haircut."

Lister grinned. "It's a deal, Uncle Gus! First thing in the morning!" END

NEXT MONTH: Gus makes the grade.

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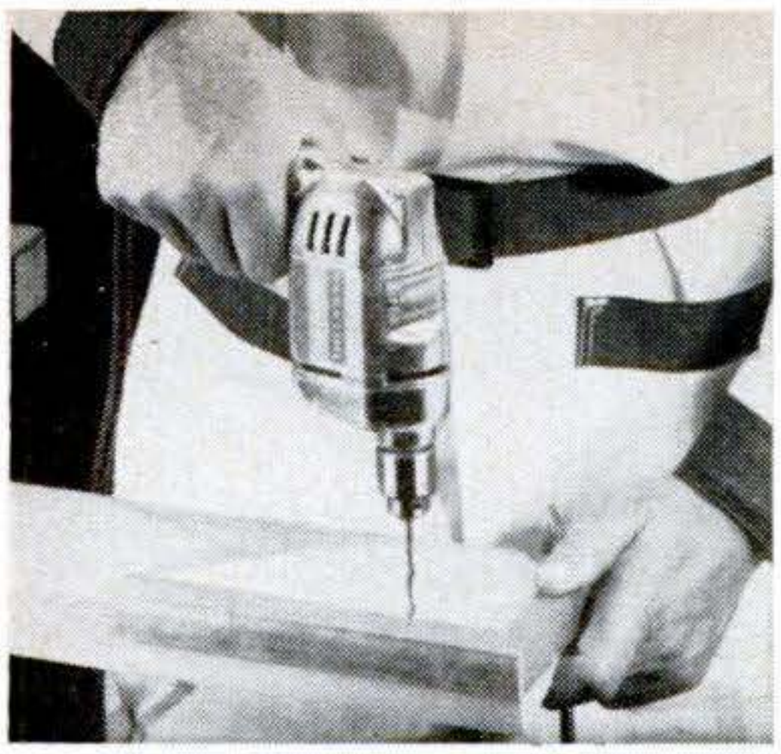

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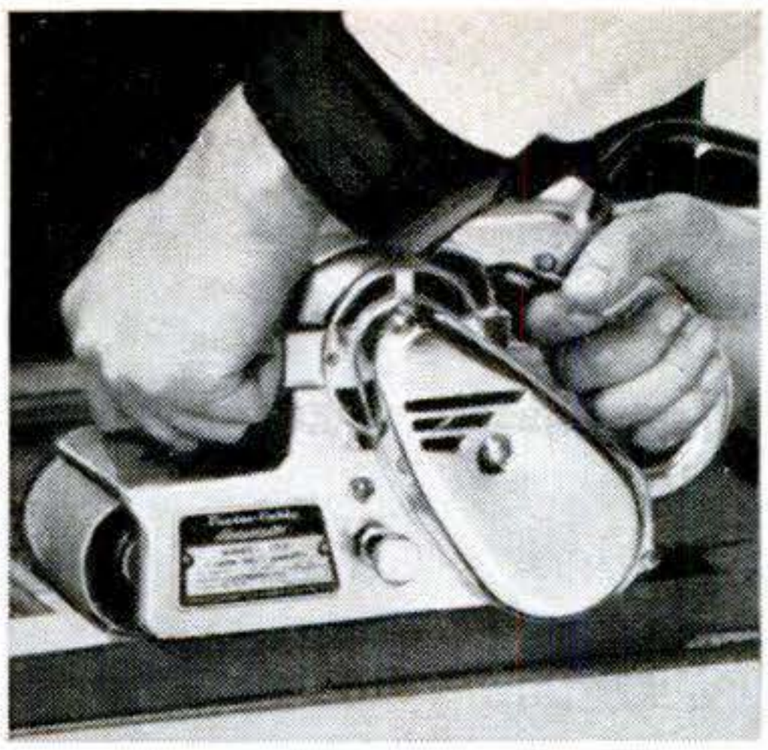

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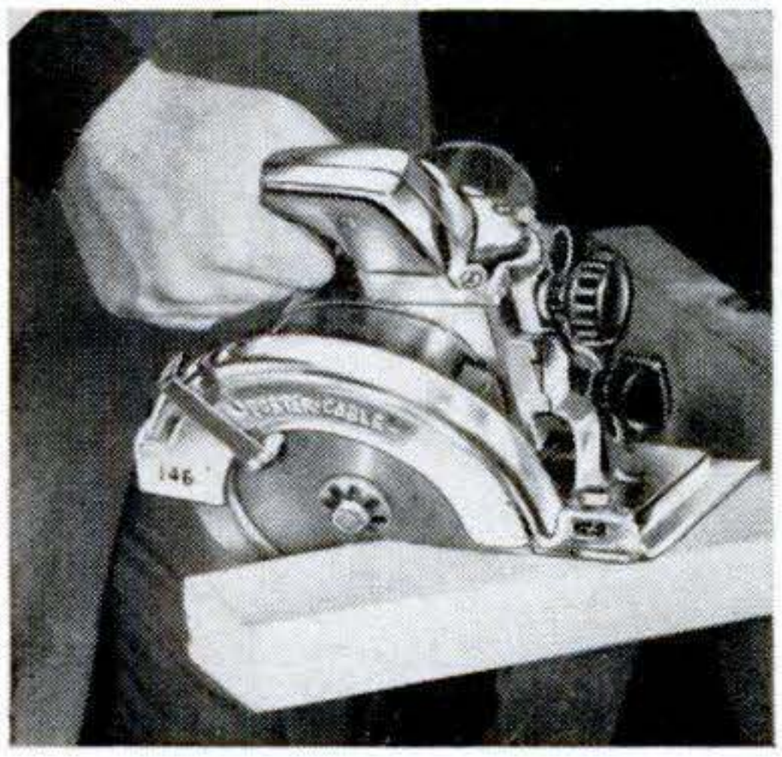

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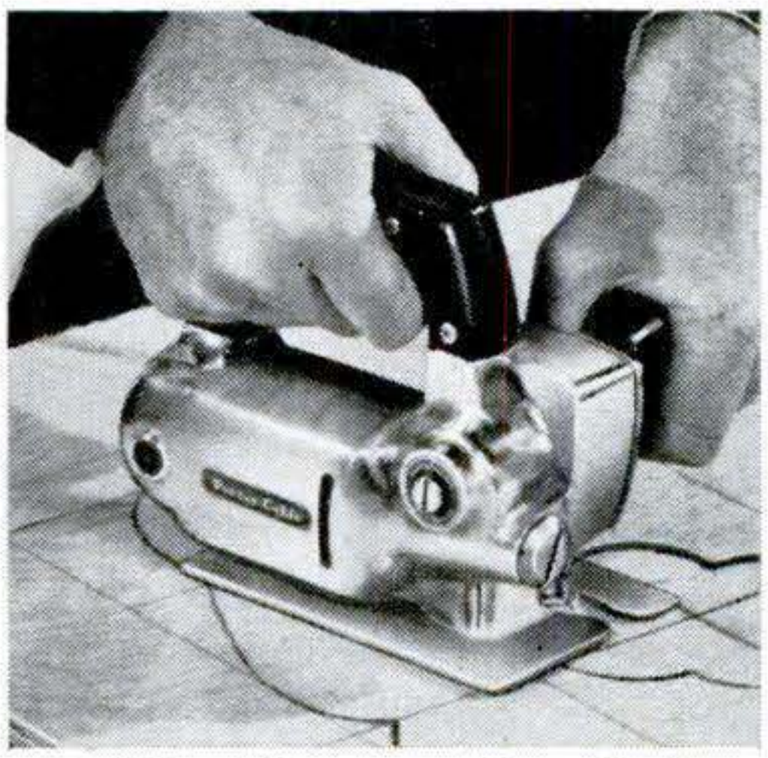

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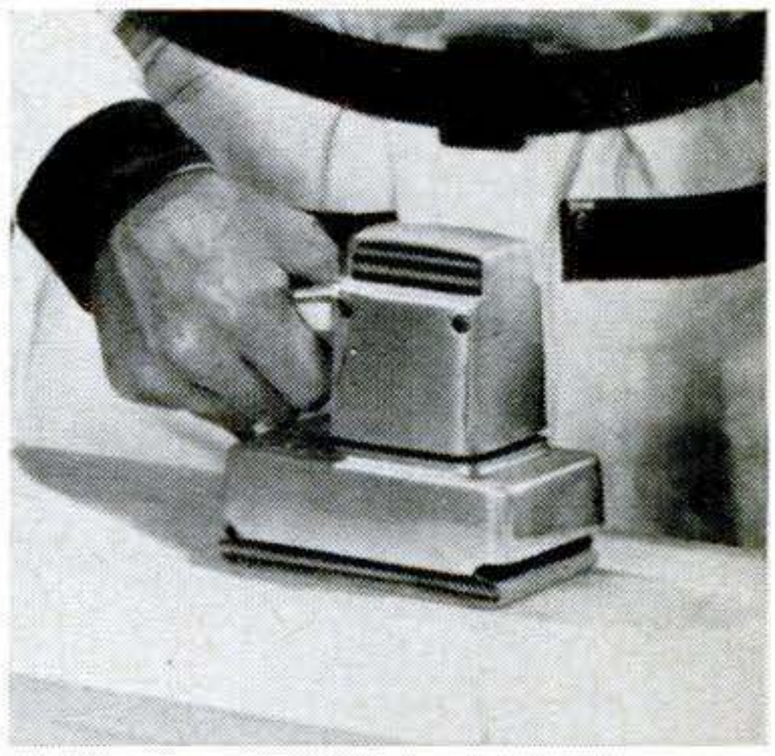

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[*Continued from page 135*]

under-25 group that have fatal results indicates that speed or highway horseplay, rather than inattentiveness or lack of skill, is a major fault of these young drivers. Among older Connecticut drivers (26 to 35) one accident in 142 killed someone in 1955. For the 16-to-25 group it was one in 97.

One teen-ager interviewed in a Cities Service Co. poll said that a car gives the average young fellow "a new-found sense of power." Ordered around all his life by adults, he may let his urge for independence run rampant when he takes command of a machine far more powerful than himself. He may use the car to bully his elders.

But these same elders may have to share the blame.

Arizona's highway chief, Charles Pemberton, points out that many adults set a bad driving example. "Children will take the same liberties as their parents," he says, "with the added daring of youth but without the benefit of the oldsters' experience."

There is no shortcut to experience. It takes years of observing accident statistics, and perhaps the awesome close-up of a bad smash, to impress a driver with the killing power of an automobile. "The best kind of driver is probably one who is a little scared," says William Corgill of the Association of Casualty and Surety Companies. "Young men just haven't had time to get scared enough."

What can be done to make young men safer drivers? They have developed one effective means themselves—the hot-rod club. Such clubs put emphasis on mastering both the automobile and its handling on the road. They fine or even expel members for traffic violations.

The city of Flint, Mich., has set up a revolving jury of 20 teen-agers. They are given time off from school to hear traffic cases involving drivers of their own age.

The National Road-E-O is a country-wide organization sponsored by the U. S. Junior Chamber of Commerce. Its activities include locally sponsored driving contests leading up to an annual championship drive-off.

According to most safety authorities, nothing takes the place of expert driver training, whether individual or classroom instruction. A check of 1,500 Massachusetts teen-agers showed that untrained drivers had nine times as many reportable traffic violations as those with class training. In a Delaware sampling, 79 percent of drivers without formal training had violations on their records; less than 20 percent of those with training had violations.

If you're a parent, by all means encourage your boy to take driver training. Point out that good sportsmanship on the road is just the opposite of football-field competition. Make fair but firm rules governing the use of the family car; don't whitewash even parking tickets—a youngster who parks with abandon may drive the same way, at far greater risk. Be adamant about his mixing drinks with driving—nobody is too young to feel the effects of alcohol. Try (and this can call for superhuman tact) to keep your boy out of cars driven by other young men with a record of violations; apart from the danger of being a passenger in such cars, bad driving habits can be catching.

You should watch yourself, too, for the very same reason. Remember, you have several years of experience on the younger fellow; imitation comes easy, but the skill that may let an older driver "get away with it" isn't in the young one yet. Says a New Jersey police official:

"It's not enough to say 'be careful' when you hand him the car keys. You have to drive carefully yourself, impress on him that speeding and showoff driving are juvenile, while care and consideration are marks of a grown man. Above all, make it clear that driving is a privilege, that when the state grants him a license, it is because he is considered fit to be trusted with human lives." END

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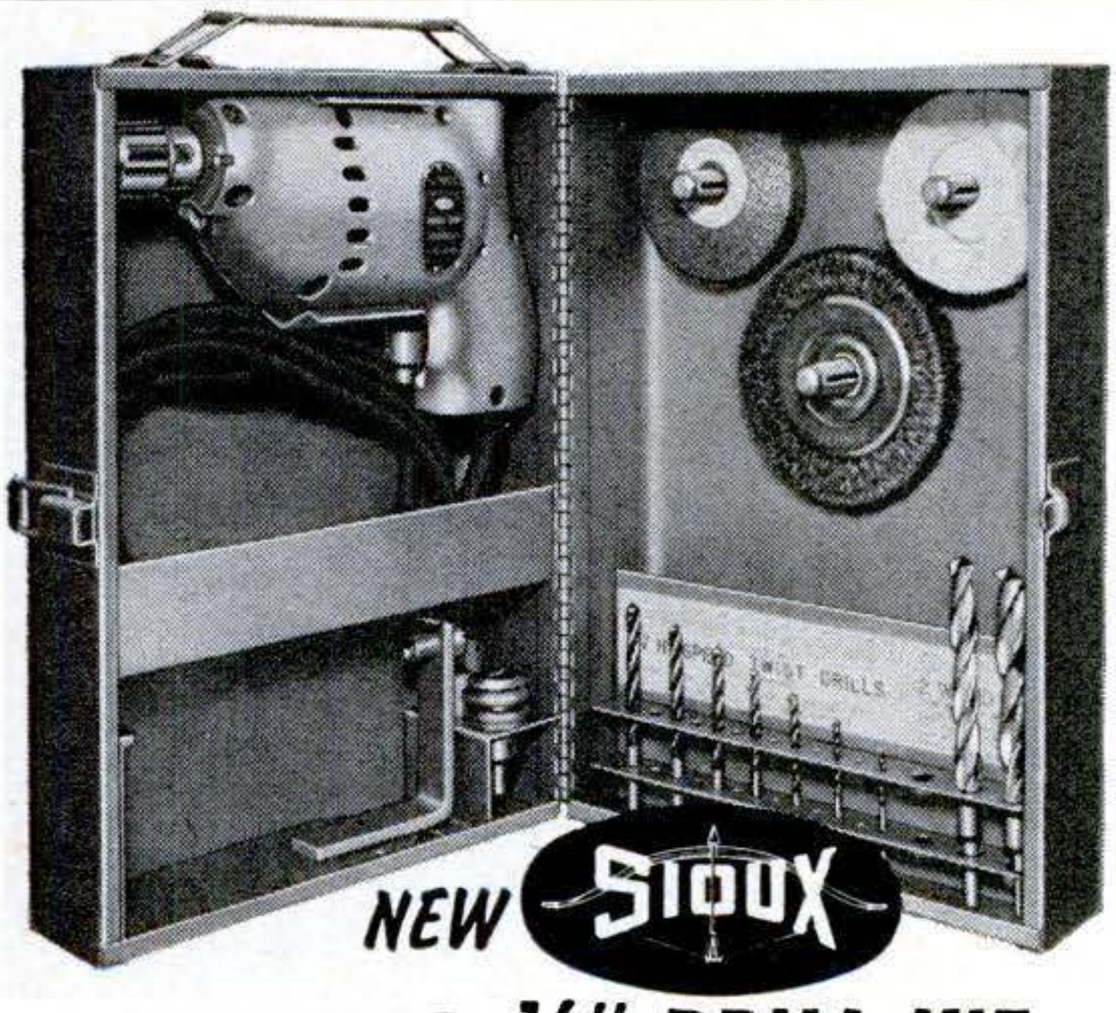

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Help kill that wild grain with
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Why risk an ugly wild grain finish when staining fir plywood, when a starting coat of *Clear* Firzite is so easy to apply. Helps tame that *wild* grain, makes fir plywood look like costlier woods. And for beautiful oak, walnut or mahogany effects, just add colors in oil.

For woodsy blond, pickled and wiped effects—use
WHITE FIRZITE

Gives that woodsy blond finish without a "painty" look. Perfect, too, for pickling and wiping. For pastel tones, add colors in oil. And use White Firzite as an undercoat . . . it's a sealer and primer in one. Helps prevent grain raise and checking on soft wood and fir plywood *paint* jobs.

For a fast, modern, natural finish—use SATINLAC®

Cuts finishing time drastically because it dries out of dust in 3 to 4 hours. Satinlac brings out and protects the natural grain and beauty of any wood—soft or hard, plywood or solid lumber. Easy to apply—easy to maintain.

Ask your hardware, paint, or lumber dealer about these Weldwood Finishing Wizards . . . or mail coupon for FREE leaflets.

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☐ Satinlac ☐ White Firzite ☐ Clear Firzite
NAME_____
ADDRESS_____
CITY_____ZONE____STATE____

Radar Bumpers to Stop Plane Crashes

[*Continued from page 132*]

miles an hour. With the coming jet airliners, this could go higher than 1,300 miles an hour.

At such speeds the equipment must allow at least 15 seconds from detection of an intruding aircraft to the time the pilot of the protected plane has completed his escape maneuver. This, in turn, means that the system for picking up a plane in a possible head-on collision course would have to be extended in future models to a range of four to six miles. To avoid false alarms, however, the computer would be set to take emergency action only should the intruder come within 800 feet.

At present, the plan is to give a pilot only one kind of escape-maneuver information: "Fly Left" or "Fly Right." When either of these instructions lighted up, the pilot would put the plane in a 45-degree bank, maintaining his altitude.

There are two reasons for these limitations. A sharper turn might bounce the passengers around and, in turbulent air, might even overstress the aircraft. A sudden dive or climb, besides the above disadvantages, might also get the plane into a more dangerous position in relation to other airliners that are flying above or below.

More flexible evasive action may become possible in the future. Collins engineers suggest that a thorough mathematical study of escape maneuvers be made on a digital computer to analyze the miss characteristics of various combinations of approach circumstances. (Including the grim chance that an escape maneuver might *cause* a collision.)

"Once we get the equipment to realize by itself that there's real danger of a crash," says Dr. David O. McCoy, assistant director of research and development at Collins, "and to figure out what to do about it, we can make it do whatever else the airlines want—sound a horn, hit the pilot over the head with a croquet mallet, jab him with 3 cc. of Salk vaccine, or just quietly steer the plane out of the danger area." END

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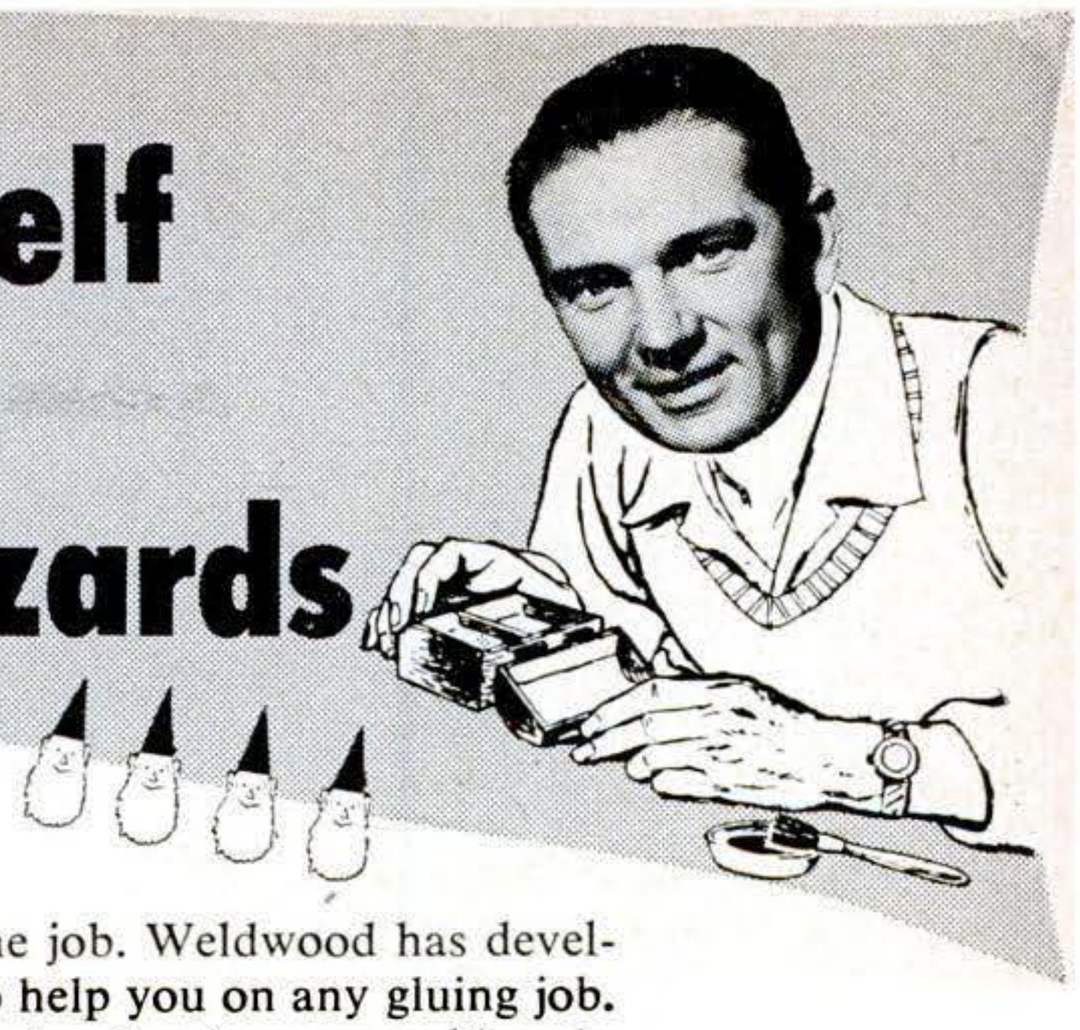
Glue-It-Yourself

with one of these

4 Weldwood® Wizards



Make sure you use the right glue for the job. Weldwood has developed four different types of adhesives to help you on any gluing job. Keep all 4 of these Weldwood Wizards handy at your workbench. They'll solve your gluing problems speedily, easily, successfully!

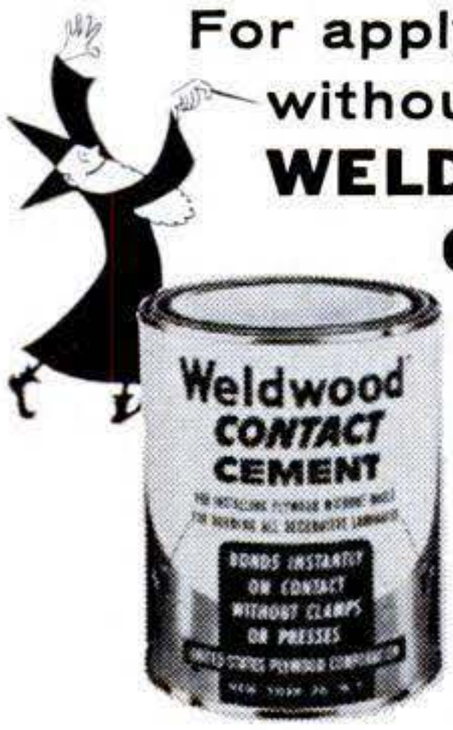
For gluing that boat of yours, use WELDWOOD WATERPROOF RESORCINOL GLUE

100% waterproof! Defies the elements! Use it for every gluing job that needs *complete protection* from climate, weather, water (even boiling, freezing or salt!), mold, fungus, etc. On boats, in damp basements, for outdoor furniture, or fixing golf clubs, etc., you can always depend on Weldwood Waterproof Glue. ¼ pts., $1.00. Also available in pts., qts., gals.

Ready to use, for fast, all-around gluing—WELDWOOD PRESTO-SET® GLUE

Yes, ready to use; sets fast and glues like magic. Presto-Set is the Weldwood—perfected white glue that bonds any combination of wood, cloth, paper, fabrics, leather, etc. Odorless—and so clean to work with. New, easy-to-use plastic dispensers. 19¢, 29¢, 49¢ and larger.

For applying plastic surfaces without clamps—use WELDWOOD CONTACT CEMENT



Bonds instantly, permanently, on contact—without clamps or presses. Easy new way to surface table tops, kitchen counters, etc., with Micarta and other plastic laminates. Easy new nailless way to install plywood panels. Scores of other uses in home, hobby, garage. 29¢, 40¢, 70¢ and larger.

For gluing wood joints like a pro—use WELDWOOD *Plastic Resin* GLUE

Powerful powder — easy to mix. Actually makes glued joints stronger than the wood itself. Favorite of top furniture-makers. America's most popular glue. Highly water-resistant, stain and rot-proof. 15¢, 35¢, 65¢ and larger.

Remember—
There's a special Weldwood Wizard for every gluing job. Ask your lumber, paint or hardware dealer... or mail coupon for FREE leaflets.

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Send me leaflets on:
- ☐ Weldwood Plastic Resin Glue
- ☐ Weldwood Waterproof Resorcinol Glue
- ☐ Weldwood Presto-Set Glue
- ☐ Weldwood Contact Cement

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[*Continued from page 139*]

train to take you to the top of a nine-story office building," said my guide. "Yet once you board El Capitan one step above platform level, you climb only one short flight and that can be it for the whole of your trip if you like. We've provided upstairs washrooms for infirm and elderly guests."

"I haven't seen any waiters racing upstairs and down with heavy trays," I commented. "How come?"

He grinned, shoved open a door, and beckoned me into the kitchen.

A 36-foot galley, agleam with stainless steel, met my eyes. It was savory with cooking odors and filled with the rushing sound of blowers carrying off scents and smoke.

It was as well staffed as a couple of hotel kitchens—one chef, two second cooks, one third cook, two fourth cooks, three pantrymen—but still no waiters.

My guide pointed to a couple of miniature elevators. "Subveyers," he called them. One was just passing out of view with a tray of spotless glasses; the other was coming down with trays stacked with dirty dishes.

"Where do you get the juice for all of those electric stoves? They look as if they'd drag a lot of kilowatts."

"The current comes from two 60-kilowatt, diesel-driven generators tucked over the dining car's trucks," the chef said. "Those generators could provide electric power for 25 five-room houses."

"How much food did you start off with today?"

My guide whipped a list from his pocket. "Twenty-five pounds of chicken, 50 pounds of turkey, 180 pounds of beef. Thirty-five club steaks, 100 pounds of assorted hams—"

"Thirty dozen eggs," inserted the chef.

"One hundred pounds of potatoes, crates of fresh leafy vegetables—"

"Three hundred individual bottles of milk, 160 servings of ice cream, and 24 quarts of cream . . ."

"Of course," the chef added apologetically, "we take on additional fresh dairy supplies at Gallup, Albuquerque and Kansas City."

Aware that we were making life difficult for him, and knowing, too, that the blunt vermilion snout of El Capitan's four-unit diesel would soon be nosing into Barstow, I asked to see the showpiece of all showpieces aboard the train. This was the "sky lounge" car.

Back upstairs we went and into this cloud-scraping heavyweight. Here, a capacity throng of 60 passengers was savoring predinner refreshments on leather-upholstered divans and easy chairs.

"Note that double row of windows arcing overhead," said my guide. "Except for a solid center panel, you can see as much as you could from a regular dome car—"

"And without the hothouse glare," commented a passenger who had overheard him.

My guide now had his watch in hand. "I'd like to show you the Kochina room right below us, but we haven't time. It's named for an Indian doll. Seats another 26 passengers. Has a snack bar, open from five a.m. to 11 p.m. Serves sandwiches, coffee, soft drinks—"

A diesel horn bleated softly in the distance. El Capitan was slowing down. Reluctantly, we hurried into an adjoining coach and down its stairway to a vestibule lined with well-filled luggage racks.

The Santa Fe man nodded approvingly at all of this cowhide, took a deep breath, and let go with his final statistic.

"Reservations for El Capitan are up 47 percent since this hi-level equipment went into service."

Why shouldn't they be, I thought to myself as I stood on the Barstow platform minutes later and watched the lordly monarch of all coach trains disappear downtrack. Any railroad that's resourceful enough to make a profitable lightweight train out of heavyweight luxury equipment is entitled to a waiting line at its ticket window. END

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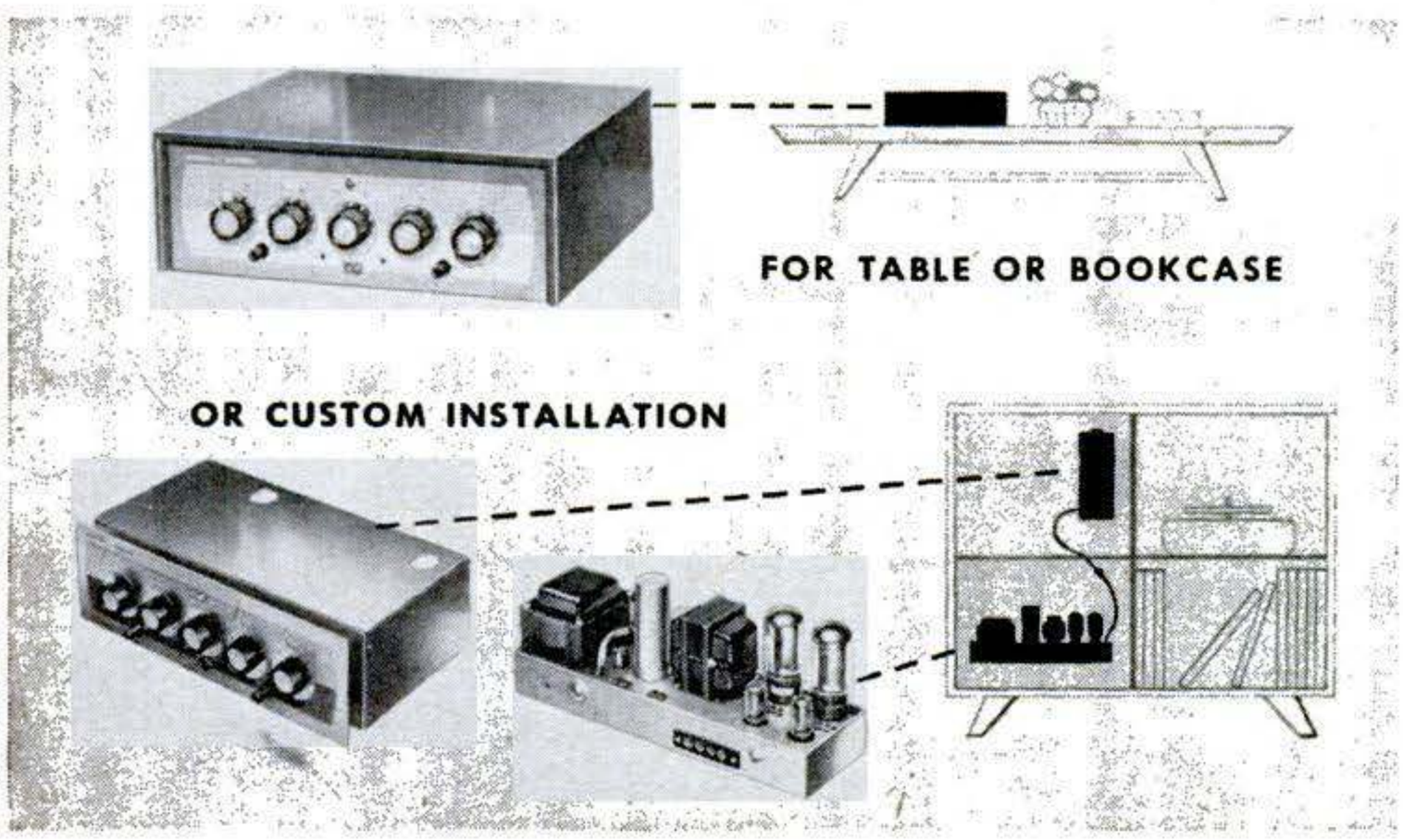
New "Convertible" 20-watt Amplifer and Pre-Amp with controls, in one versatile unit, only $99.95

THE new G-E Convertible is a dual-chassis design. In a single, amazingly flexible and low cost unit there's a powerful amplifier, with 20 watts of undistorted output—plus a pre-amp with seven panel-mounted controls. It gives you sound as it was meant to be heard.

There's New Installation Flexibility, too! With General Electric's dual-chassis design, the amplifier and pre-amp may be mounted independently in built-in systems. Or, as one complete unit, the handsome Convertible may be placed on a bookshelf or table.

Write today for new hi-fi ideas and the name of your dealer. He can show you the full line of General Electric Hi-Fi components. *General Electric Company, Special Products Department, Section R6117, Electronics Park, Syracuse, New York.*



Progress Is Our Most Important Product

GENERAL ELECTRIC

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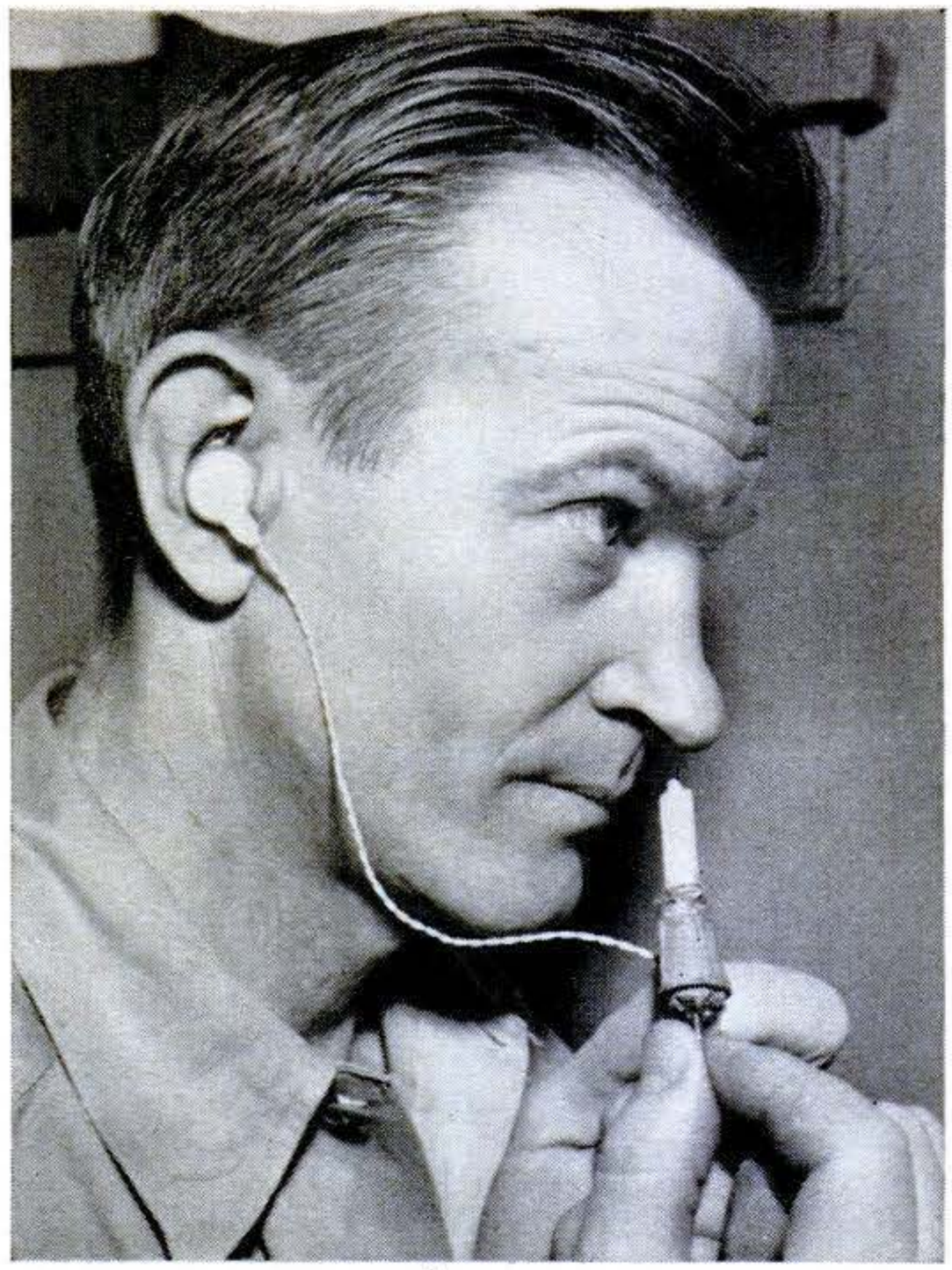
Horns Get Traffic-Din Tests

THIS truck is used to test combinations of chords designed to help auto-horn signals override modern traffic din. Here Delco-Remy engineers try out a high-frequency B-flat note to hear how it sounds in a closed car, at varying distances and against noisy competition.

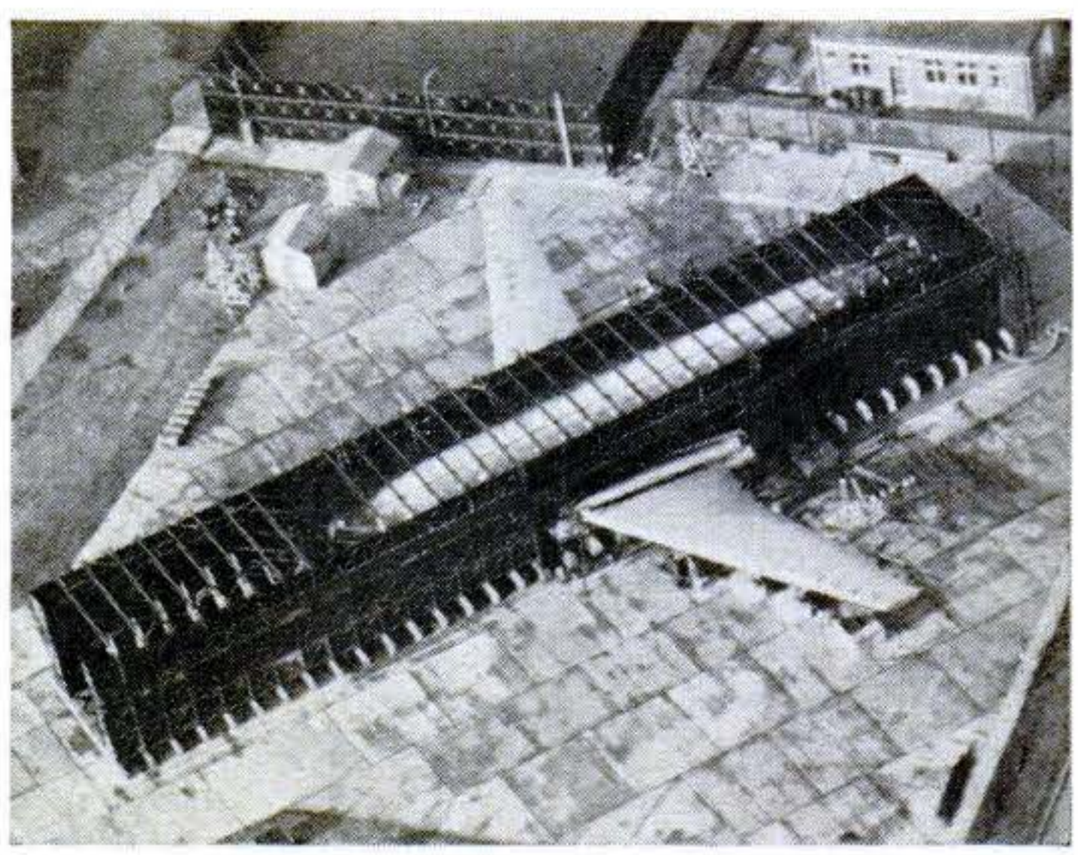


Thimble Radio Gets 125 Miles

POWERED by penlight and hearing-aid batteries, this half-ounce receiver tunes in the 88-108 megacycle FM band. Range is 125 miles without antenna or grounding. Its builder, Glen K. Ecker of Pasadena, Calif., uses it above with an earplug phone. It also hooks to an amplifier.

Novel Pencil Doubles as Gauge

THE mechanical pencil above can be used for writing and also as sliding calipers extending up to four inches. Made by Fend Brothers, P. O. Box 116, Pforzheim, South Germany, the pencil-gauge is turned out in a variety of models plated with gold, silver or chrome.



Air Stresses Tested in Water

A BRITISH Comet 2 jet airliner is shown submerged in a water-filled test tank built by De Havilland at Hatfield, England, to simulate the stresses and strains that occur in actual flight. The tank, 140 feet long, 20 feet wide and 16 feet deep, holds 290,000 gallons of water.

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New! For furniture, cabinets, built-ins—

Weldwood Old Craftsman Pine Plywood

the easiest working, easiest painting plywood ever!

American Hutch Cabinet. Photo from Fawcett Publications' "Furniture You Can Build."

Combining all of the advantages of pine lumber:

- Easy to work
- Cuts clean, sands smooth
- Easy to paint, stain, finish natural
- Paints more quickly
- Covers with less paint
- Less grain show-through

With all of the advantages of plywood construction:

- Large (up to 4′ x 10′) sizes for less joining and fitting
- Tremendous strength
- No splitting
- Greater stability
- Resists warping

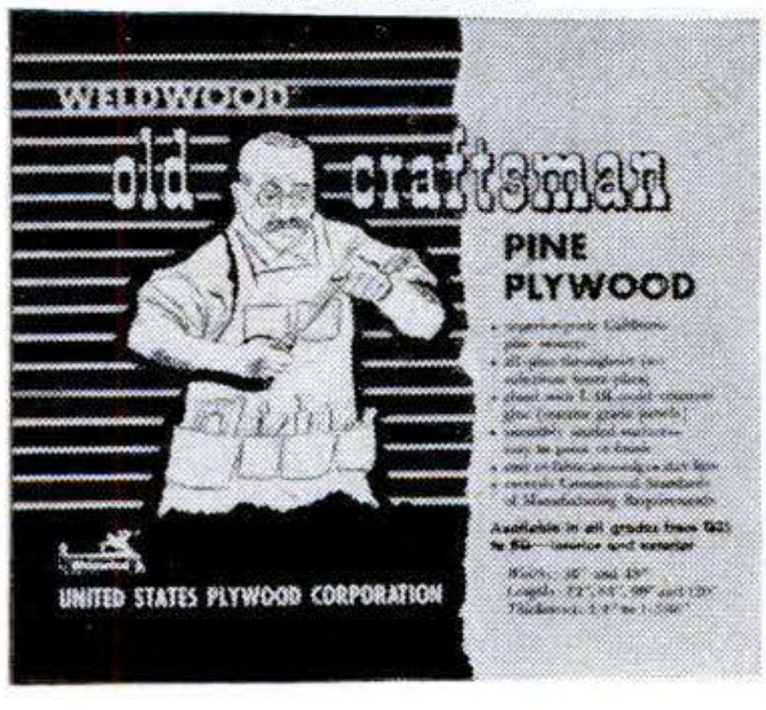
FOR many years, professionals have demanded pine plywood when they make built-ins, cabinets, toys and furniture. And now Weldwood has increased production so that Weldwood Old Craftsman Pine Plywood is available to everyone!

This is the finest pine plywood. It's all pine throughout, and made with an exclusive, mold-resistant bonding agent; available in interior and exterior grades. Old Craftsman Pine is carefully made, yet, it costs even less than cabinet-grade birch. Comes in sizes from 3′ x 6′ to 4′ x 10′; thicknesses from ¼″ to 1 3/16″. So, next time you start a project, do what the "pros" do—insist on genuine Weldwood Old Craftsman Pine Plywood.

Weldwood® Old Craftsman Pine Plywood

A product of **UNITED STATES PLYWOOD CORPORATION** *Weldwood—The Best Known Name in Plywood*

Look for this label.



United States Plywood Corporation
Box 61, New York 46, N. Y. PS 1-57

Please send me a FREE SAMPLE and complete information about Weldwood Old Craftsman Pine Plywood.

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CITY.....STATE.....

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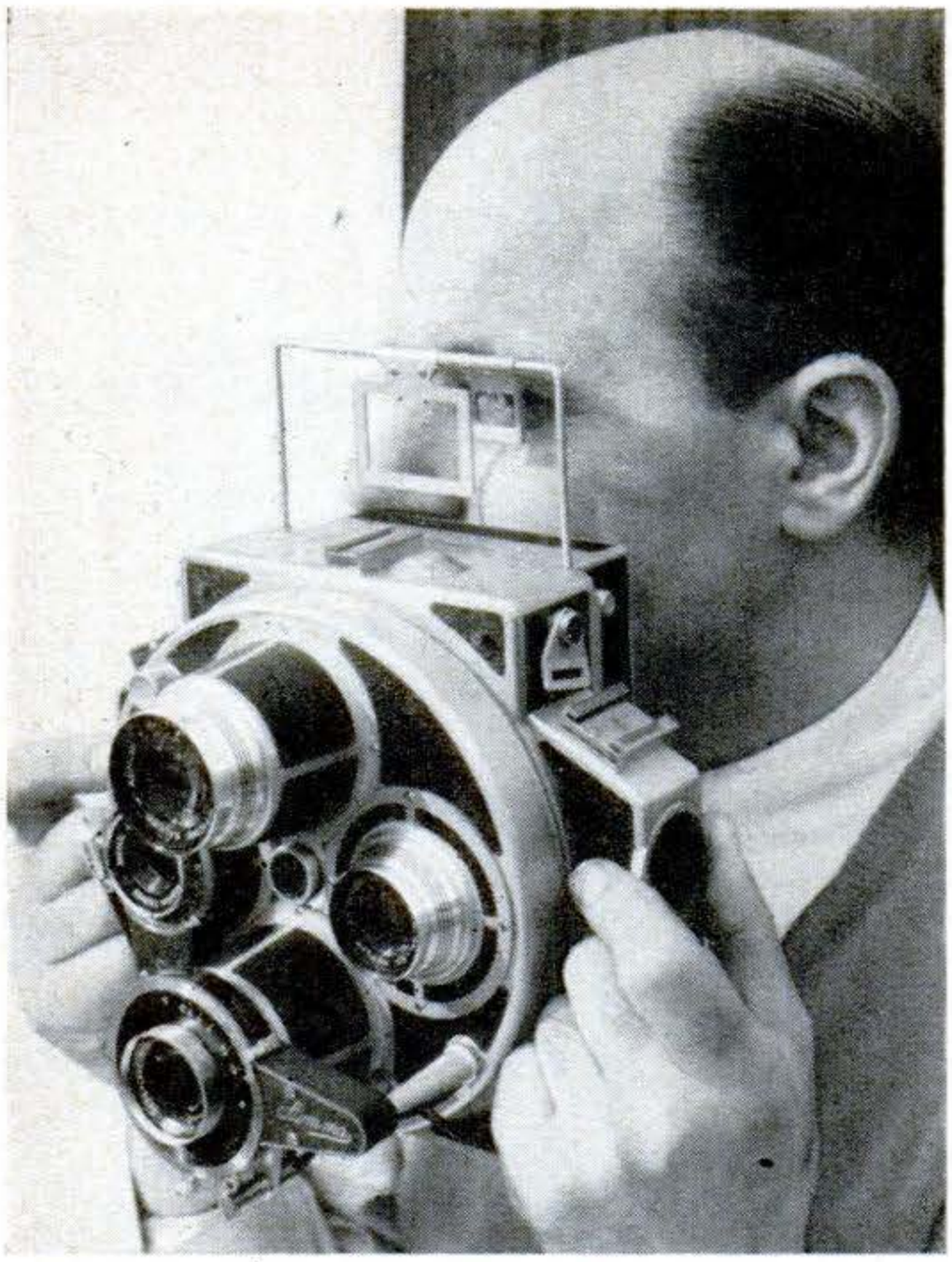

Italian Camera Has Four Eyes

THIS new still camera has a revolving turret, like some movie cameras, which gives a choice of two lenses: normal (bottom) and wide-angle (left). The other two "eyes" are the viewing lenses. The Italian-made Summa also has built-in hand grips and dual flash attachments.

Air Conditioner Is Jet-Driven

A GIRL holds the tiny supersonic rotating assembly of a jet-driven air conditioner designed for jet airliners. At left is the turbine, driven by compressed air from the engine. At the other end is a rotor which, the Carrier Corp. says, could easily cool seven houses.

Mirror Gives True Reflection

A 3-D mirror that gives an exact, not a reverse, image has been developed in England. Two mirror wings set at angles to each other enable the girl above to read the London *Times* in its own reflection. U. S. agents are Dorset Light Industries, Inc., 24 West 40th St., New York.

"Flying Crane" Hefts Half a Ton

ALTHOUGH this 2,850-pound, twin-engine Omega is a lightweight among copters, it can carry a freight load of 1,020 pounds, plus pilot and two hours' fuel supply. The model shown is a stripped experimental version. A later model will carry five men, 320 pounds.

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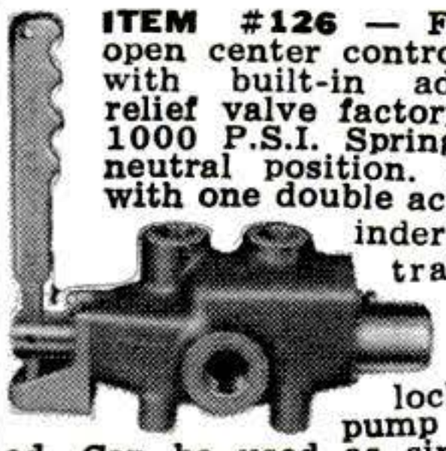
TOP VALUE SPECIALS!

SURPLUS ITEMS AT FRACTION OF ORIGINAL GOV'T. COST

AT GROBAN'S

GROBAN FOUR-WAY OPEN CENTER HYDRAULIC CONTROL VALVE



ITEM #126 — Four-way open center control valve, with built-in adjustable relief valve factory set at 1000 P.S.I. Spring loaded neutral position. For use with one double acting cylinder. In neutral position cylinder is locked and pump unloaded. Can be used as single unit or mounted in series. Has 3/4" pipe thread inlet and outlet. 1/2" pipe thread cylinder ports. Finger grip handle. Ship. wt. 10 1/2 lbs.

AN OUTSTANDING BUY!

F.O.B. Chicago **23.50**

DOUBLE ACTION HYDRAULIC CYLINDERS

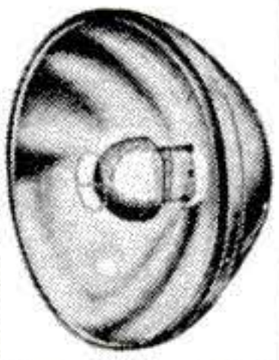
ITEM #31C—3 1/2" bore, 11" stroke. Alloy steel cylinder wall. Micro-Honed and all steel 1 1/8" diameter piston rod. 19 1/2" overall length closed. Clevis mounting at base and shaft. Will lift 9625 lbs. with 1000 PSI Pump Pressure. Uses 3/8" tubing fittings. (Fittings to pipe thread: two 3/8" MPT @ 35c.) A $102.00 value. Shipping weight 11 lbs. FOB Chicago.. **25.00**

ITEM #16-C—1 1/2" bore, 26" stroke. Will lift 1760 lbs. with 1000 lbs. pump pressure. Great for hay loaders, etc. 1" stainless steel piston rod. Postpaid **16.95**

G.E. SEALED BEAM 300 WATTS 110 VOLTS SPOTLIGHTS

THROWS A BEAM TO 1000 FT.

Item #418



General Electric "Mazda" 5 1/2" Sealed Beam. Uses conventional 110 Volt current—Fine for lighting up driveways, signs, parking lots, displays, garages. Built for use as Flashing Signal for U.S. Navy—to stand heavy surge loads. Shipping Wt. 2 lbs. U.S. Gov't. Cost $12.68 ea.

Now Each ..... **2.50** Postpaid

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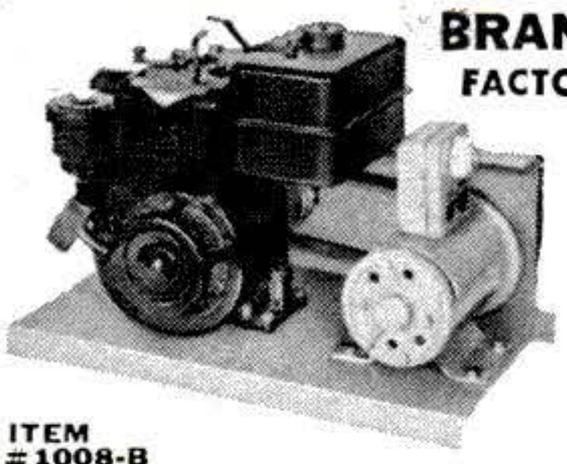


PORTABLE ELECTRIC LIGHT PLANTS

ITEM #1008-B

Dimensions:
Length 20 1/2"
Width 12"
Height 16"

POWER TO OPERATE:

● Water pump, Radio, Lights, Air-conditioner ● Refrigerator, Deep Freezer, Incubator ● Electric Saw, Electric Drills, Pipe Bender

Compact—Fits in the Trunk of Your Car

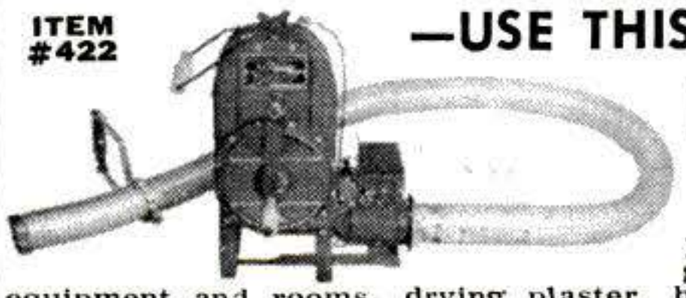
FULL 1000 WATTS continuous duty. 115 Volts, A.C. 60 cycles, 9 amps. Powered by husky Briggs-Stratton engine with recoil starter. Engine and generator operate at 3600 R.P.M. for maximum efficiency at minimum weight. Both units are mounted on steel base, with heavy sheet metal belt guard. Generator is self-regulating, and is equipped with outlet box containing fuse and 2 A.C. convenience receptacles. Cost only 5c an hour to operate. Shipping wt. 100 lbs. (Regular price $225). You save $65.50. Now only, F.O.B. Chicago **159.50**

700 WATT—GENERATOR SET—same as above, slightly smaller—with Briggs-Stratton Engine—Model 708—F.O.B. Chicago. **129.50**

ITEM #2008-2000 WATTS 115 V. A.C. generator set, powered by husky, fast starting Briggs-Stratton engine. Mounted on portable steel carrying base for easy handling.—Just right for small cottage and cabins needing inexpensive 2000 Watts of electricity. Ship. Wt. 190 lbs. F.O.B. Chicago **295.00**

TO START YOUR ENGINE THIS WINTER —USE THIS BRAND NEW PORTABLE HEATER

ITEM #422



Ideal for preheating engines, warming farm equipment and rooms, drying plaster, burning weeds, melting ice and snow, burning off paint.
Burns any gasoline, gives intense blow-torch type heat.
STEWART WARNER Model 796A—rated 40,000 B.T.U. Complete with 6' flexible heat duct, 5 pint gas tank, carrying handle, blower fan, fuel filter, Tillotson carburetor and full instructions.
U.S. Air Force paid $81.75
Shipping Wt. 25 Lbs. F.O.B. Chicago **Now only 22.50**

U.S. NAVY ALL BRONZE CENTRIFUGAL PUMP

These all bronze Centrifugal Pumps are ideal for use as marine bilge pumps, circulating pumps, fire protection or irrigation, car-washing, dewatering, basement sump pumping, lawn sprinkling. Will pump water, oil, brine, gasoline, DDT and sulphur compounds. Equipped with 6" adjustable 'V' pulley, 2" dia. inlet and outlet, 180 GPM capacity. Inlet and outlet take hose with 2 1/4" inside diameter. Dimensions 11"x8"x11"....

Total head-feet	Speed	H.P.	GPM
25	3600 RPM	3	180
35	3000 RPM	1 1/4	90
20	2400 RPM	1/2	75

ITEM #384

Back plate may be rotated for most convenient inlet position. Shipping weight 31 lbs. Govt. cost 96.00. F.O.B. Chicago.... **29.50**

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GROBAN SUPPLY CO. Dept. P.S.-1

1139 S. WABASH AVE., CHICAGO 5, ILL.

300 AMP. D. C. GENERATORS

IDEAL FOR WELDING GENERATORS

ITEM #91

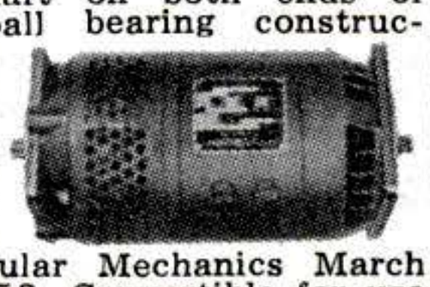
Type R-1, rated 300 Amps. — 30 Volts. Mfd. by General Electric & Ford. Government Acquisition Cost $380.00. Shpg. wt. 55 lbs. Dimensions: 16"x10"x7". Complete with instructions to connect as Welder. F.O.B. Chicago **35.00**

ITEM #90 — When connected as a welder, this unit will deliver 200 amps for a sustained period and 250 amps for intermittent service. This generator is widely used for shop-built portable welders. Rated 200 amps, 28 volts, 2500 R.P.M., using 10 H.P. Dimensions: 15" L. x 6" W. x 8 3/4" H. Splined drive shaft. Gov't. Acq. cost $300.00. Shpg. Wt.: 51 lbs. F.O.B. Chicago..... **22.50**

ITEM #99—12 V.—50 Amps.—Leece-Neville generator for autos, trucks, road machinery, boats and battery charges. Precision aircraft quality construction, with life-time grease sealed ball bearings and heavy insulated windings. Standard 4-bolt square mounting flange, spline shaft. Dimensions: 16" L. X 8 1/2" Dia. Wt. 23 lbs. Gov't. Acq. cost—$92.00
Now F.O.B. Chicago.... **16.50**

HOBART 2 H.P. 12-24 VOLT ELECTRIC MOTOR

ITEM #315—Rated 24 volts D.C., 90 amps, 4000 R.P.M. Has 1/2" spline shaft on both ends of motor, ball bearing construction, as specified for use with electric wheelchair design Popular Mechanics March issue, 1953. Convertible for use on 6 to 12 volts. Shipping Wt. 21 lbs. Dimensions: 11" x 5" x 6 1/2".



F.O.B. Chicago **13.00**

1-H.P.—12 VOLTS ELECTRIC MOTOR

100 Amps, 5600 R.P.M. Double shaft, ball bearing construction. **Item #308.**
F.O.B. Chicago **12.50**

MULTI-PURPOSE HYDRAULIC PUMP OR MOTOR

ITEM #55

Silent, high efficiency, Helical Gear Type Ball Bearing, Hydraulic Pump or Motor. Rated 8 Gal. Per Min. At 1500 R.P.M.—delivers 1000 P.S.I. Using 6 H.P.—Reversible Rotation—3/4" Pipe Thread Inlet and Outlet Ports —1/4" Drain Port—3/4" shaft with keyway and flat for either direct or pulley drive. Dimensions—5 3/8" high, 7 1/4" long, 5 1/8" wide. Shipping weight 18 lbs.
F.O.B. Chicago **52.50**

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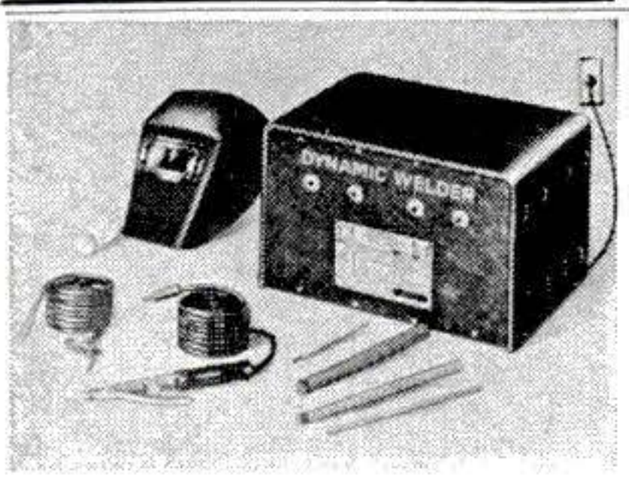
Send Payment Or Purchase Order Today



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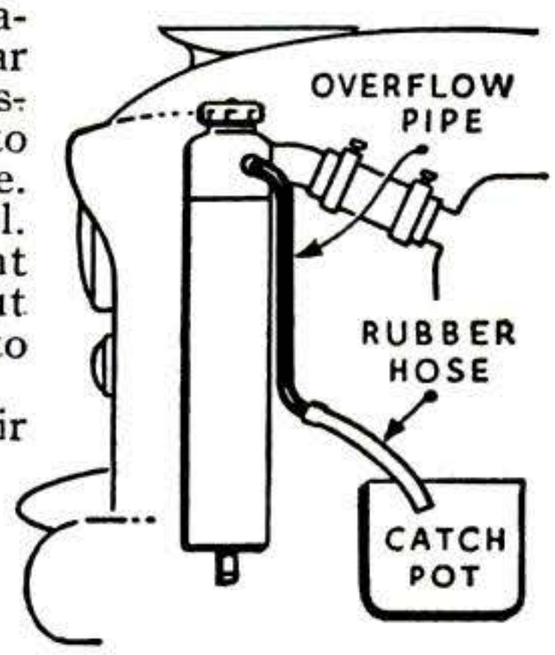
Care and Feeding of Engines

BY S. P CORP

AIRLEAKS CAUSE LOSS OF COOLANT

Air drawn into the cooling system may raise the level in the radiator causing loss of coolant through the overflow pipe. To check for air leaks on the suction side of the pump:

1. With water level in radiator at line stamped on its rear block, open radiator cap pressure valve and attach hose to lower end of overflow pipe.
2. Run engine in neutral. When gauge reaches constant operating temperature put free end of rubber hose into bottle, or catchpot.
3. A continuous flow of air bubbles out of the end of the hose is an indication that air is being sucked into the system through waterproof seal, lower radiator hose or cylinder head gasket.

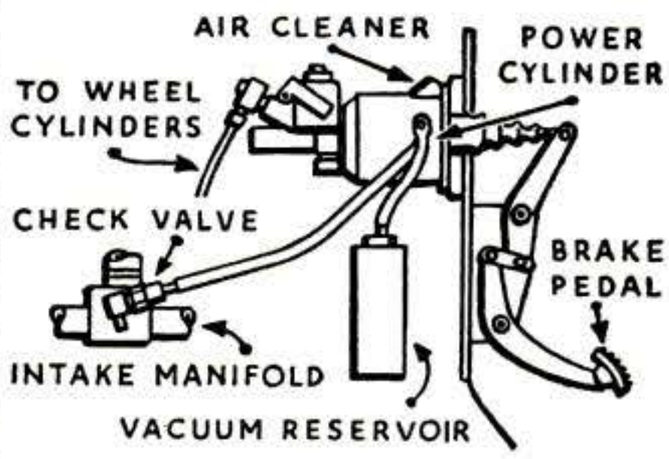


"CATCHPOT" INSTALLATION

FORGOTTEN AIR-CLEANERS

Engine bearings, pistons, rings and cylinder walls wear rapidly when dirty air enters the engine. Even when the carburetor air-cleaner is kept clean the air-cleaner at the oil filler tube may be neglected, resulting in high oil-consumption.

If your car has power brakes, there is a third air-cleaner which must be serviced twice a year. Air is taken into the engine through the intake manifold when power brakes are released. If this air is dirty, it may be the cause of excessive engine wear. To prevent this, remove the air-cleaner hair filter, wash in a cleaning solvent, dry and reinstall.



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How to Choose the Right Amplifier

[*Continued from page 216*]

low-output cartridge you will also want an amplifier that has a noise and hum level well below its rated output.

Controls. Though you want music to come out "flat"—without loss or emphasis in any tone—it's never recorded that way. For several reasons, record manufacturers boost the volume of high-pitched music and diminish the lows. Your amplifier has to compensate for these variations.

Until recently, a number of different "recording curves" were used, but all hi-fi record manufacturers have now standardized on the RIAA curve. If you're just starting your record collection, this one record-equalization position may be enough; if you have a library of older records, you may prefer three or four others. Amplifiers that use separate high and low frequency controls for equalization offer a larger—but not particularly useful—variety of choices.

The loudness control on some amplifiers is a new gadget, different from the volume control. It compensates for the peculiar way the human ear responds to a passage that is played softly—low-pitched sounds get lost more than the high-pitched ones do. You might say that the music itself changes according to the playback volume level. A loudness control restores those lost sounds.

Scratch and rumble filters. A good amplifier magnifies turntable rumble and record noise as well as the music. Filters cut out these noises. Though they also steal some of the "high" from high fidelity—by blocking part of the music—the part you *do* hear sounds better.

Installation. A lot of amplifiers no longer look like gadgets stolen from a laboratory workbench. You can get covers for most, and some chassis are built flat to fit into handsome, oblong cases. These could sit out on a living-room table without apology. But overly compact design may bring ventilation trouble, shortening tube life. And a sizeable premium seems to be tacked on for the pretty packages. END

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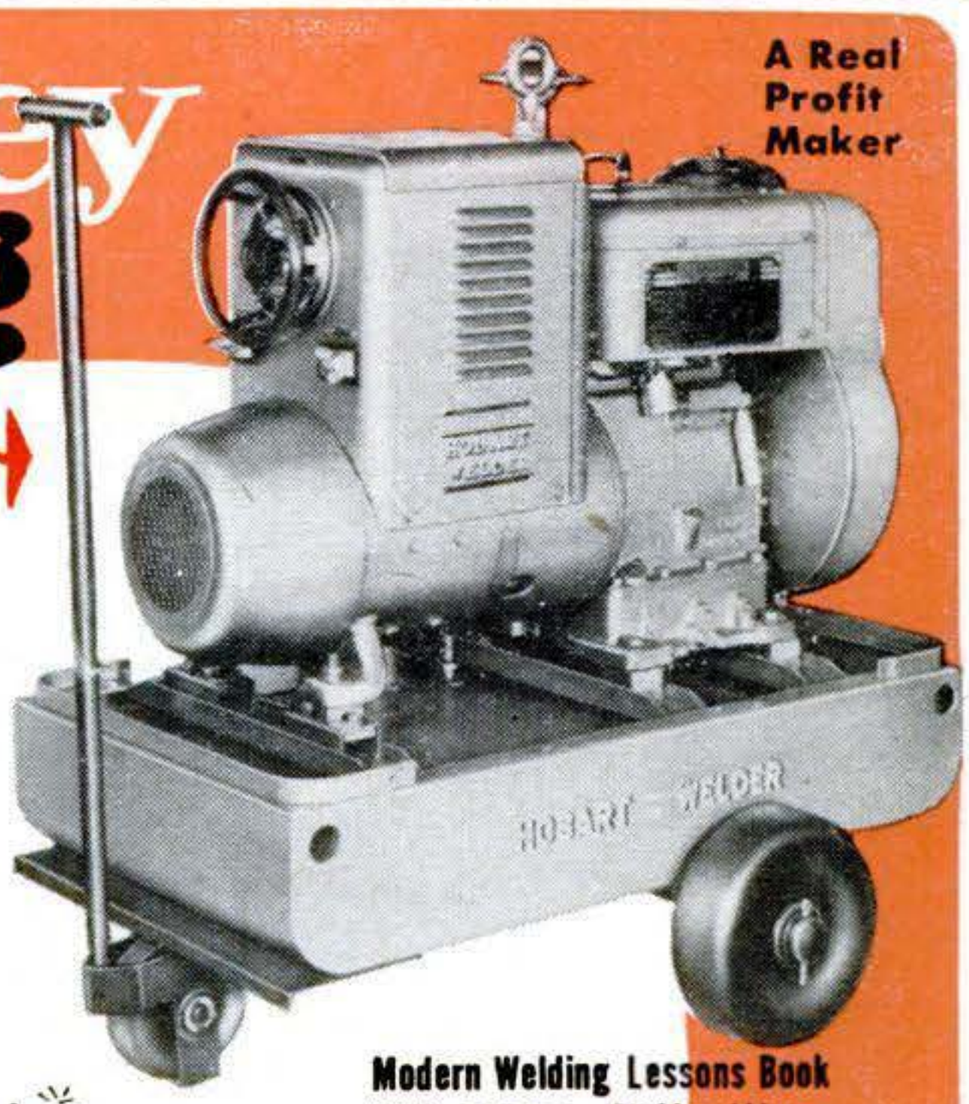

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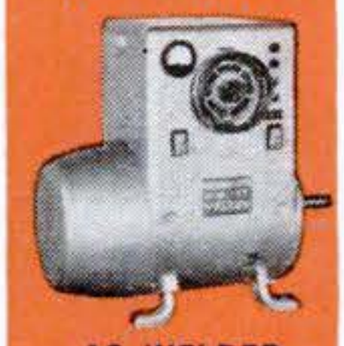

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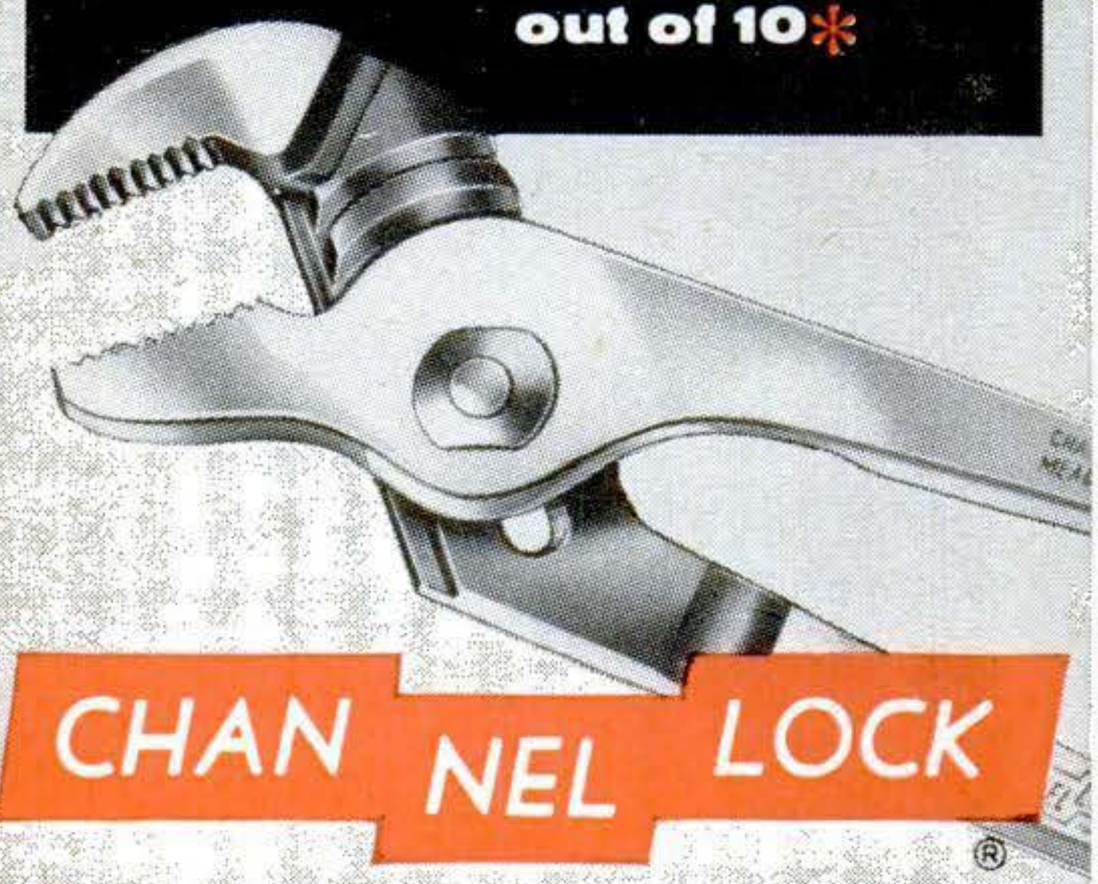

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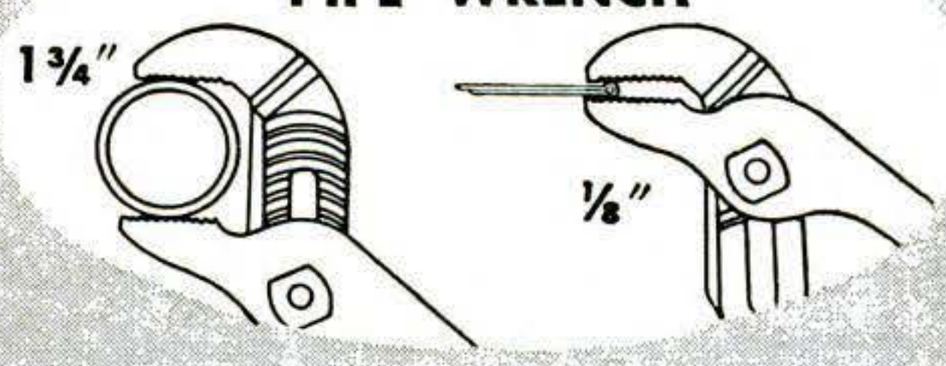

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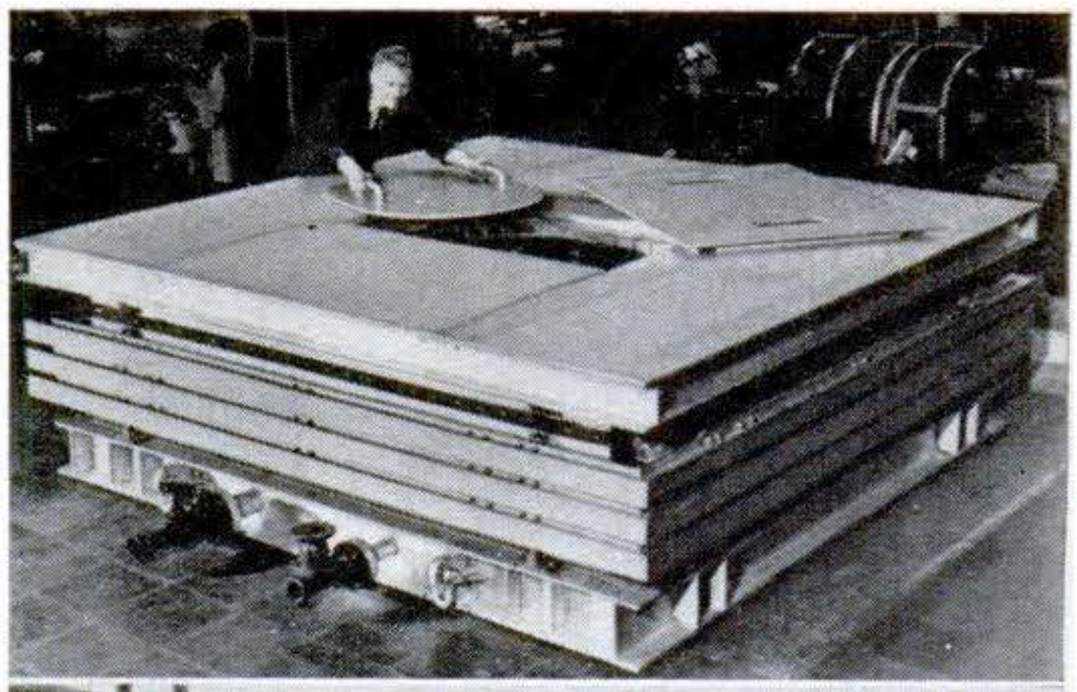

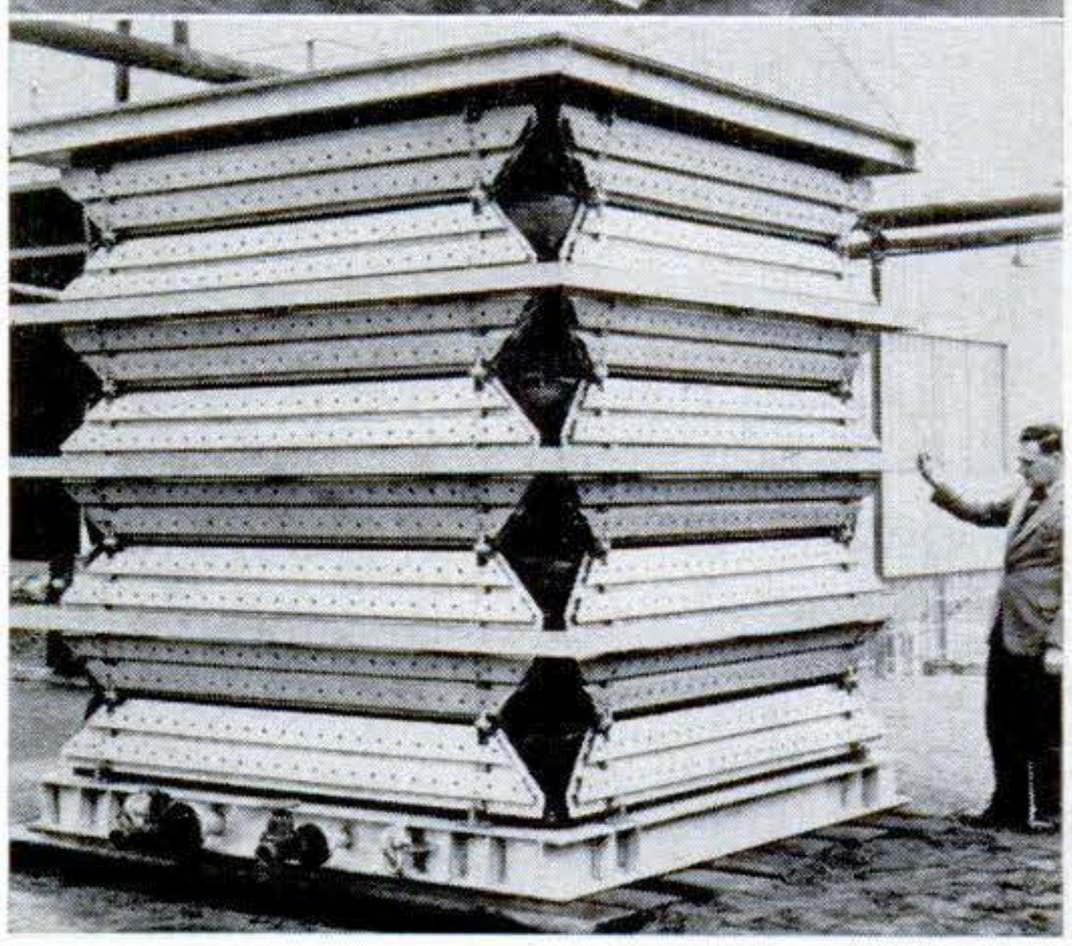

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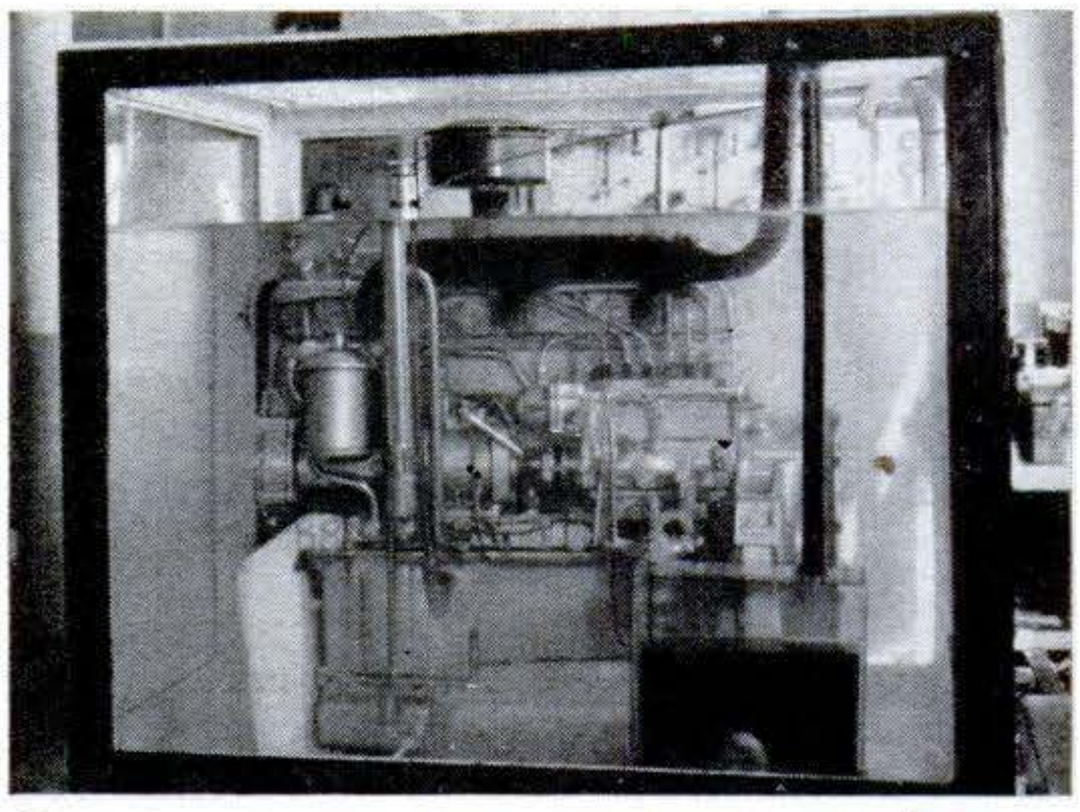
WITH this extended tank in its hold a ship can haul liquid one way, unload, then fold up the tank (top) so dry cargo can be stowed on top going back. A rubber bag, inside the metal shutters of the British device, collapses when empty.



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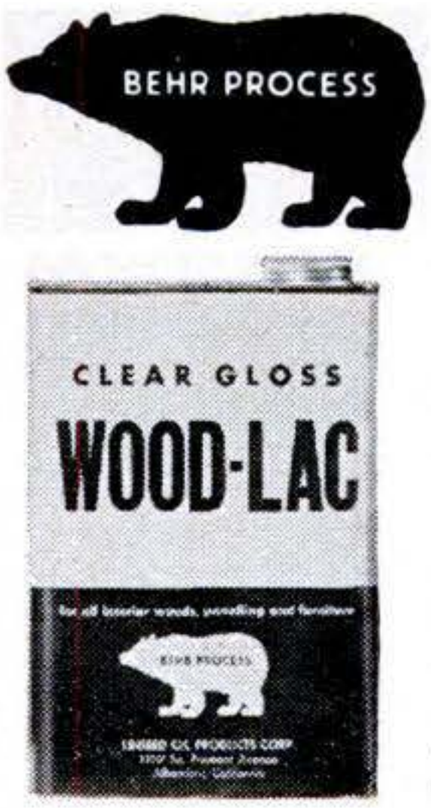

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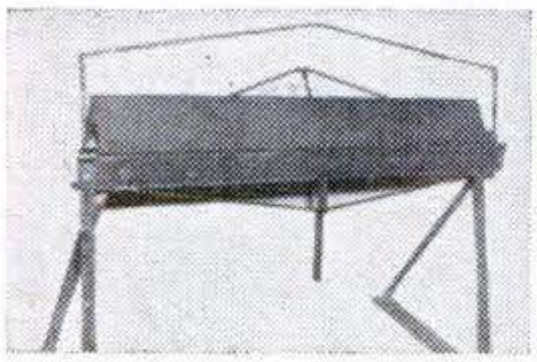

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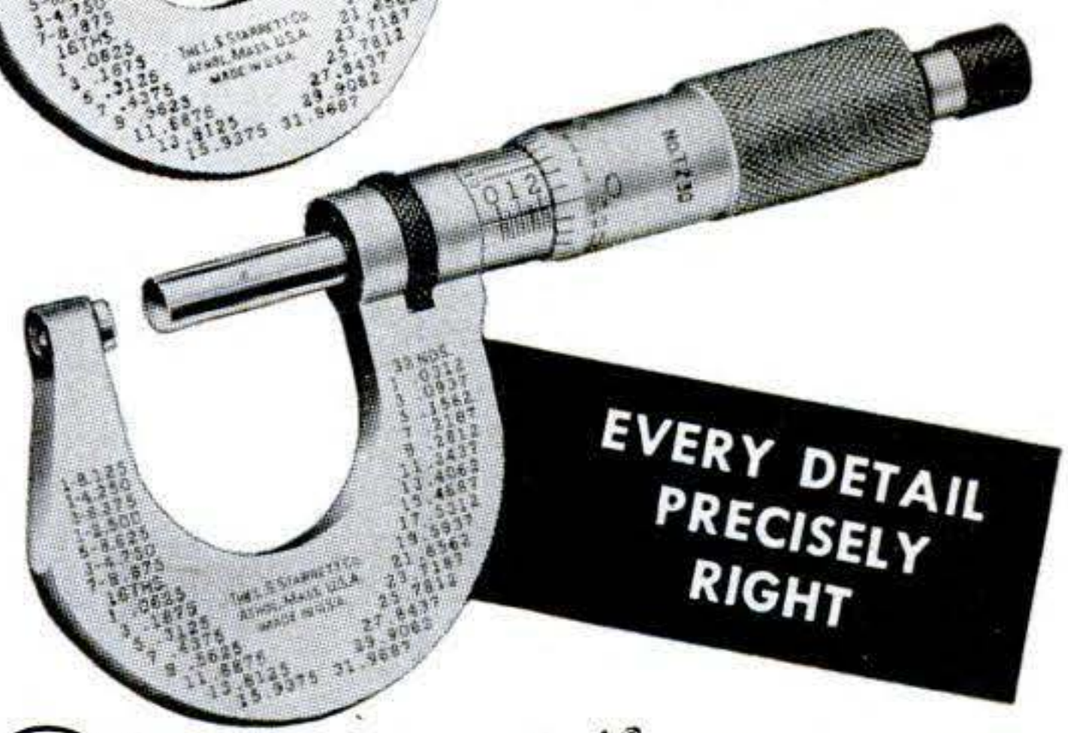

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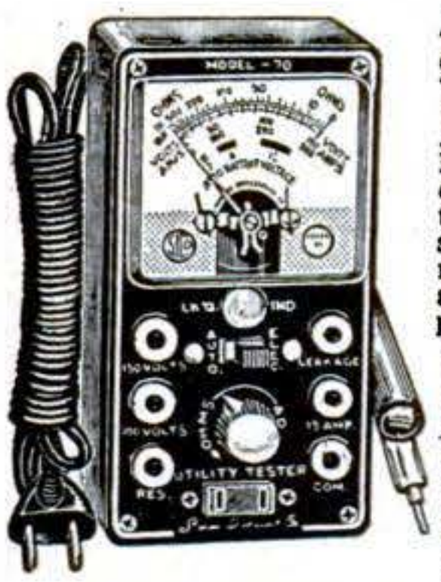

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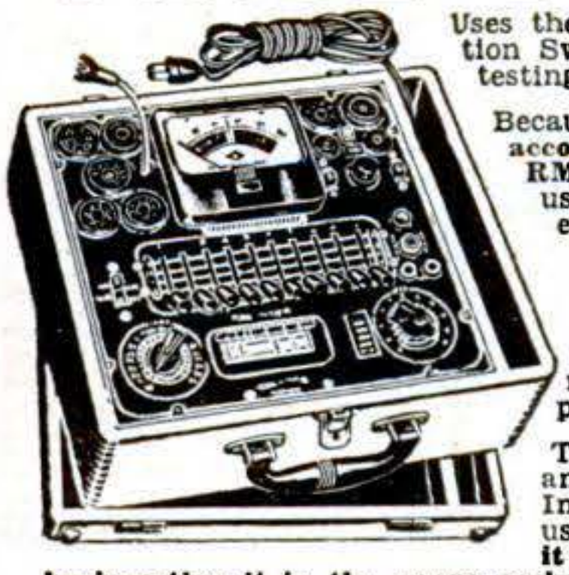

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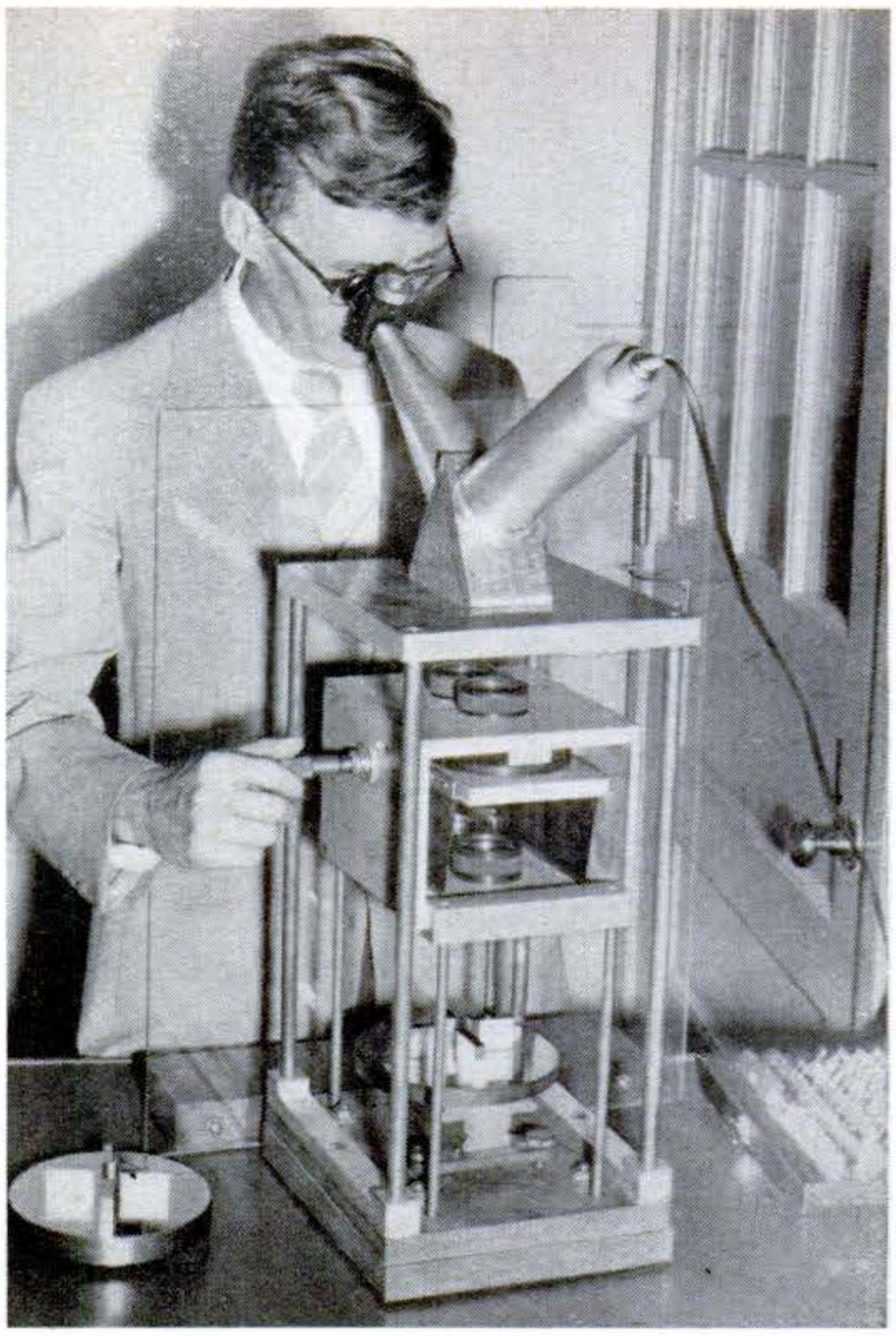

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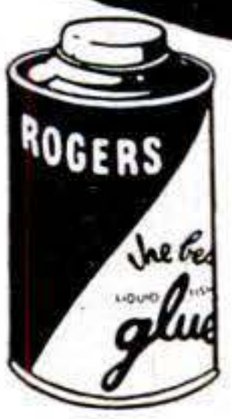

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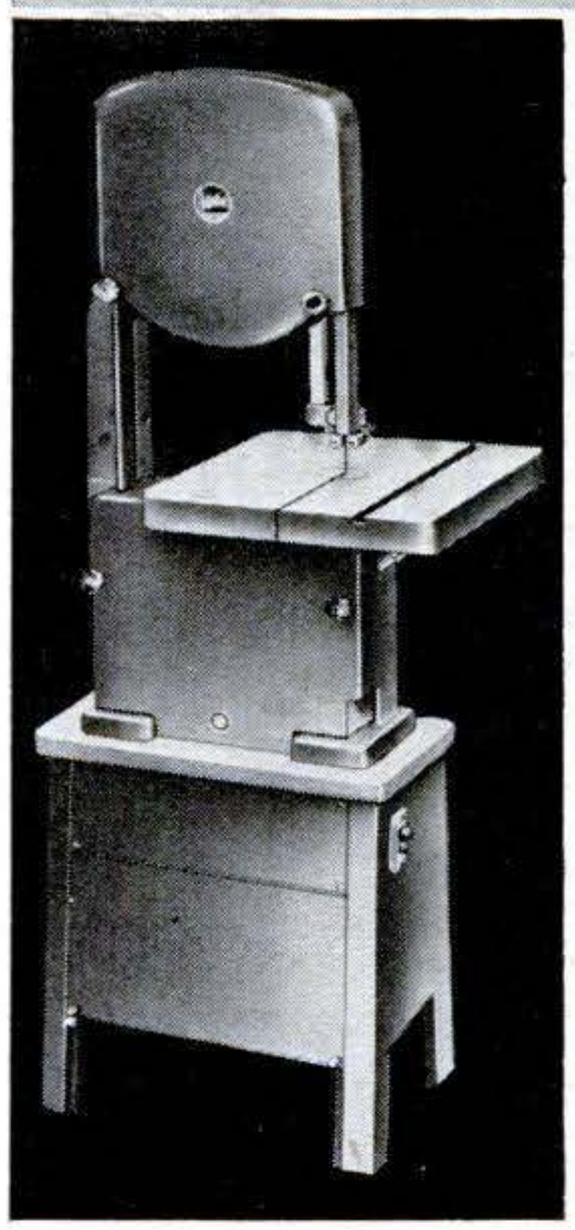

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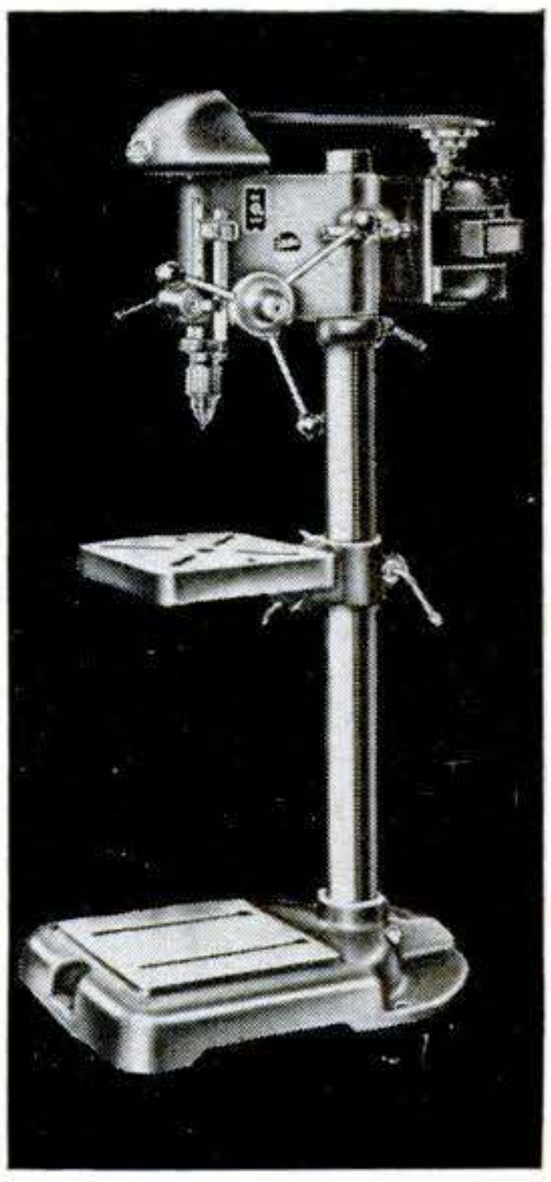

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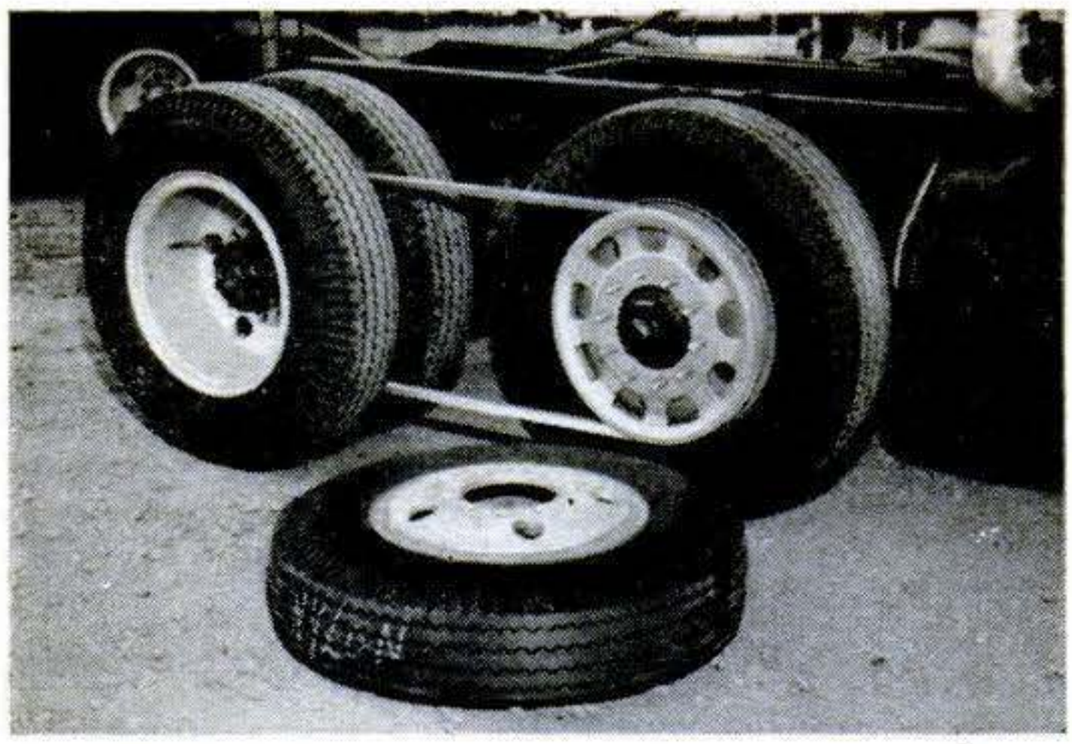
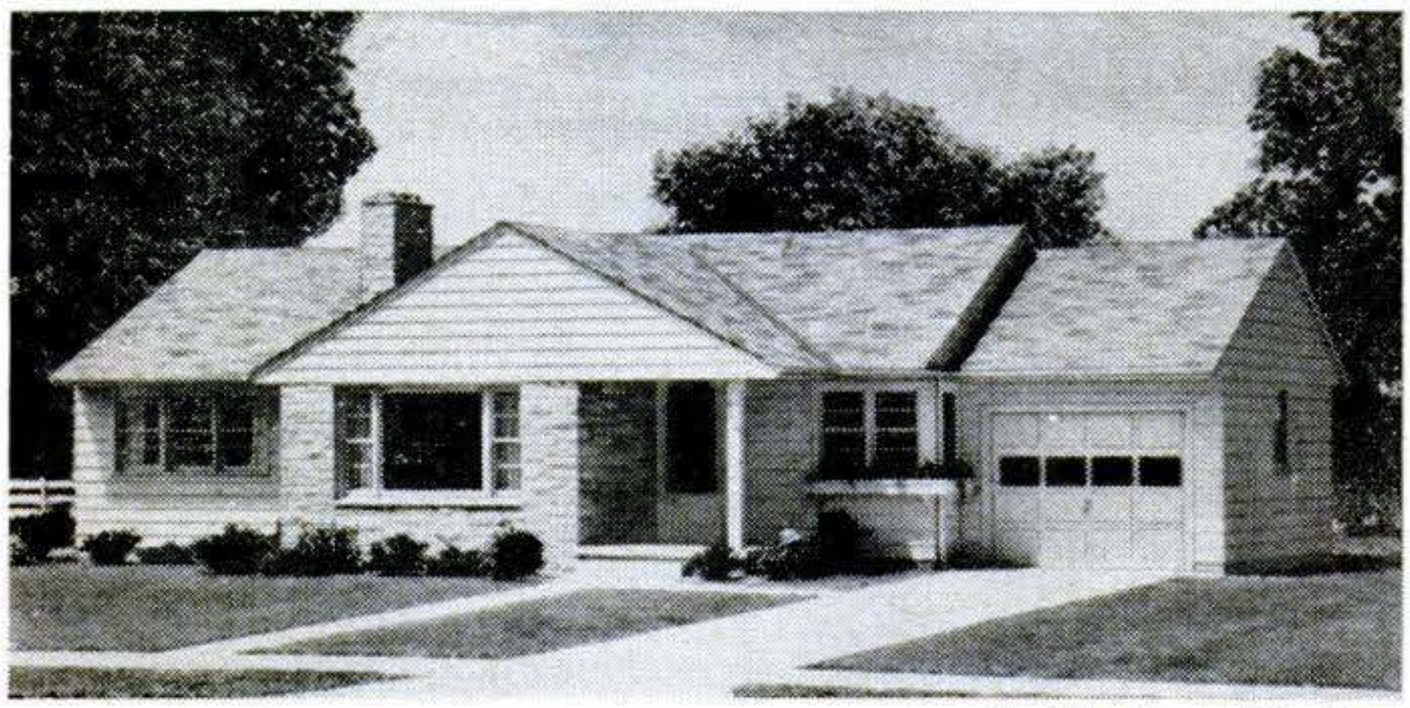


Linked Wheels Give More Push to Trucks

BETTER all-weather traction and smoother braking are provided by this tandem belt drive for truck axles. The belt transfers from 85 to 93 percent of torque to the extra wheels. The drive, including four sheaves and two belts, weighs only 165 pounds. Sterkel Tandem V-Belt Drive, Denver, makes it.

Build this beautiful Liberty Home yourself

... or direct its construction!



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43 designs—$2376 to $7950

Cape Cod bungalows. Long, low ranch homes with 2, 3, 4 bedrooms. Brick, siding or shake exteriors. Large living-dining areas, "dream kitchens". All plans included. Build with basement or utility room. Individualize in many ways.

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Liberty Homes are acceptable for FHA or VA financing, and recommended by banks and savings and loan associations throughout the country. Full details in our catalog.

MATERIALS SHIPPED COMPLETE . . . FREIGHT PREPAID

The Liberty Home materials specified for the home of your choice are shipped complete ready for erection. No shipping charges.

Save thousands of dollars either way

The unique Liberty Home Building Plan outlines every step for you. Blueprints, working plans are simple, easy to follow. Lumber is precut to exact size...each piece numbered. Do all the work yourself, or hire carpenters and still save.

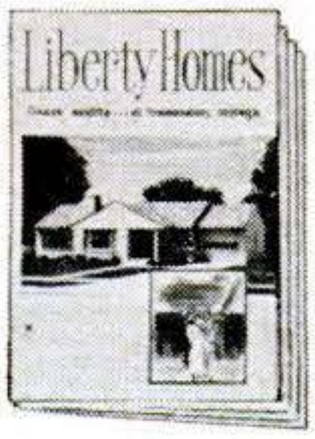
ONLY HIGHEST QUALITY MATERIALS USED

You receive fully-seasoned, Kiln-dried materials throughout. Green lumber is never used in a Liberty Home. Only the best nationally advertised finished products are included. All materials guaranteed as represented.

"I am very pleased and satisfied with my Liberty Home. All my friends are amazed to learn that I did practically all of the work myself."
J. C. Lindberg, Ohio

Send for colorful 52-page catalog

43 Liberty Homes in full color with detailed floor plans. Send 25c today.



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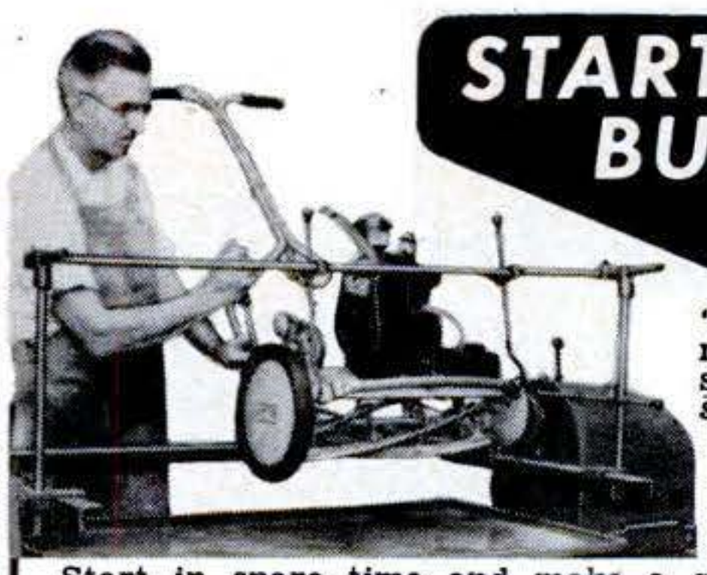

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Start in spare time and make a quick CASH PROFIT. The Foley handles up to 3 or 4 mowers per hour—prices run $1.50 to $3.00 for hand mowers, $5.00 to $8.00 for power mowers. You make 99% profit!

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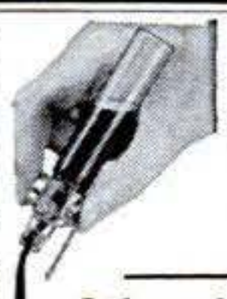

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HOBBY "Professional" results every time. Simple, easy to use. Order now.

MFRS Ask about heavy duty industrial striping tools.

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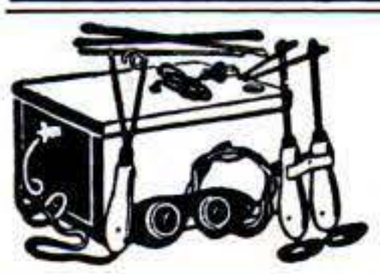

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Look for this in your hardware store — the newest, cleverest, most convenient method for buying your screws and bolts, and for keeping them handy for quick use! Sparkling clear-plastic boxes, brilliantly labeled, are packed with generous quantities of top-quality screws. NOT an assortment. Each box contains one size only. Available in 40 most-wanted sizes and types. Start to "STOCK your SHOP" now!

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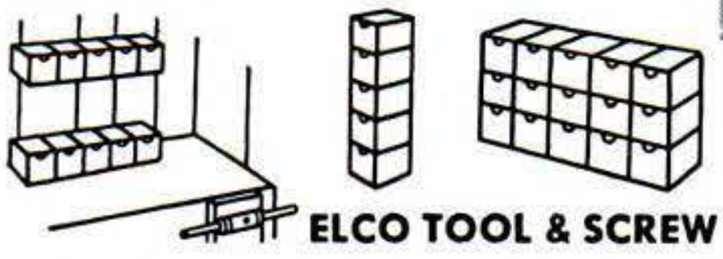

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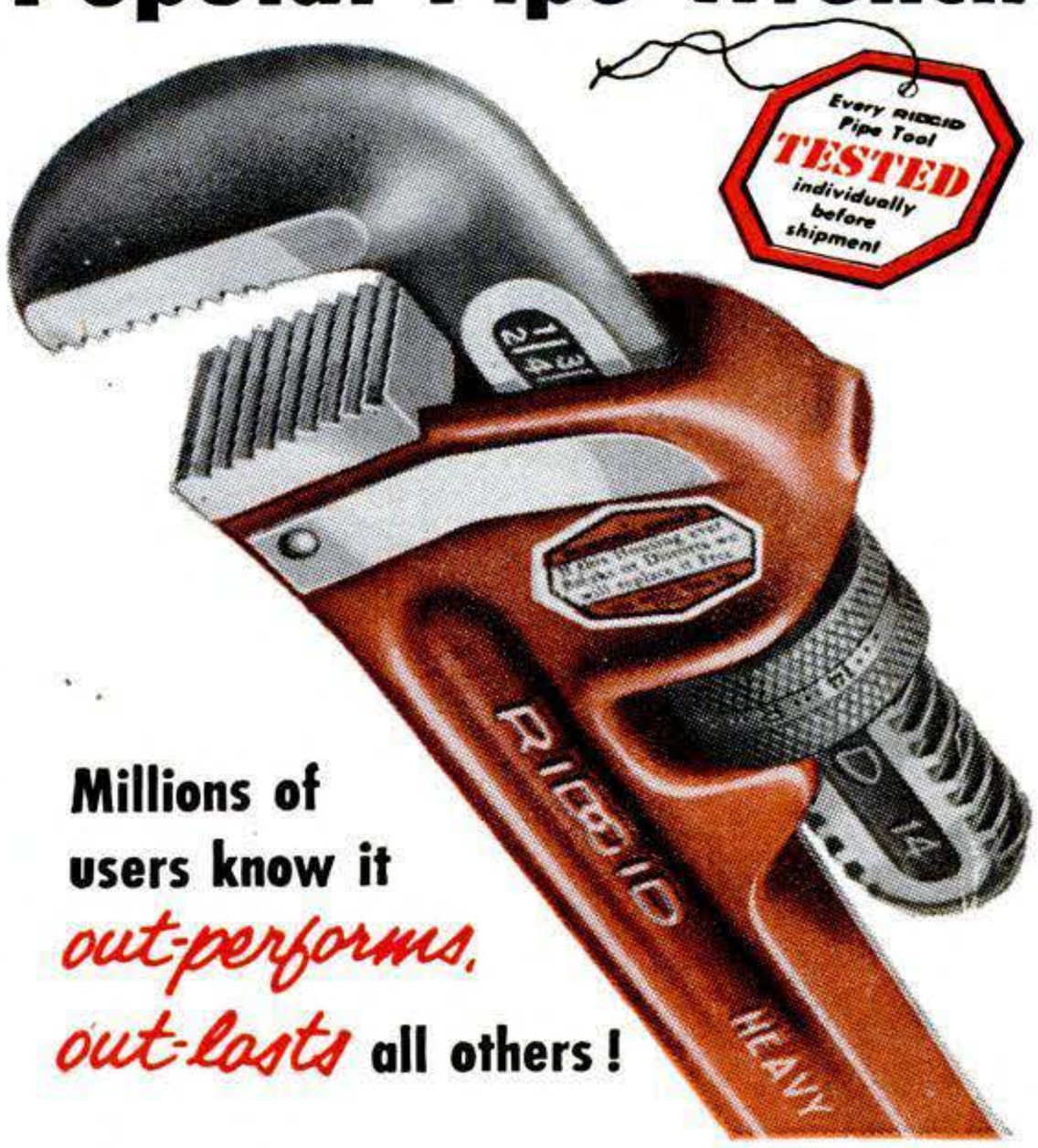

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It's the "RIDGID" name that guarantees you everything you want in a pipe wrench—instant bite on the pipe or conduit, instant let-go—it can't lock because of patented hookjaw suspension . . handy pipe scale, easy-spin adjusting nut, comfort-grip I-beam handle and every one factory-tested before shipment! For your work, for your home, it's most for your money—buy it at your Hardware Store!

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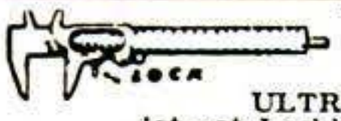

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ULTRAPRECISION — Imported. Used by machinists at Lockheed, Douglas, Bendix, GM, RCA, GE. Model 51/2E. Genuine Helios. Hardened lapped precision surfaces. 1/1000" and 1/128" graduations. Handy slide roll and thumb lock. Quick, accurate depth. A $35 value. De Luxe finish. ALL NEW. Just **$6.95**. Leather carrying case, **$1 extra.**

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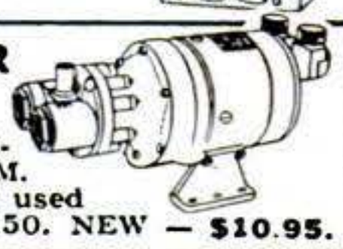
HEAVY-DUTY RHEOSTAT Designed for heavy-duty use with Air Force heated suits. Ideal for regulating voltage on electric welders, model trains, lights, generators; controls soldering irons, etc. Rated 5.75 ohms, 100 watts with double windings and dual female 25 amp. 125 volt receptacles. Size: 7" H x 5¼" W x 1¾" D. Shpg. Wt. 2½ lbs. Approx. GOVT. COST $25. Brand new, only **$1.95.**



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Can be used for pumping fuel, oil or wherever hydraulic pressure is required. Pump has 1" connections, built-in relief valve, adjustable up to 1500 lbs. Max. capacity 6 GPM. 1½ H.P., 24 volt motor, 4000 RPM. Can be used on 12 to 36 volts. Approx. GOVT. COST $350. NEW — **$10.95.**

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KIT No. 25—1 ea. Bendix Hydraulic Pump & Motor. 2 ea. Hydraulic Cylinders—7¾" stroke, 1⅛" bore, ⅝" shaft, 13" overall. 1 ea. 4-way valve. 1 ea. hydraulic pressure gauge, 2000 lb. pressure dial. 1 ea. purolator oil filter. Approx. GOVT. COST $500. Shpg. Wt. 38 lbs. **New—$30.50.**
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Buy power for pennies. Ideal for welding, battery charging, emergency lights for cabins, camps, trailers, aircraft or wherever power needed. Easy rope pull starting. Fully equipped, ready to start. 2000 W. 32 V. 5 HP. Complete, nothing else to buy. Like new, tested. Shock mounted. De Luxe type. Net wt. 115 lbs., gross wt. cased 200 lbs. Approx. GOVT. COST $700. While they last— **$59.95.**

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BUILD YOUR OWN ARC WELDER, LIGHT PLANT OR BATTERY CHARGER
Complete Kit $39.95
Kit consists of: 1 Famous Navy NEA-5 Generator. New! Combination AC-DC Type. AC voltage—115 V. DC voltage—24 V. 200-300 Amps. 2 complete generators in 1 . . . 2 separate fields & 2 separate armatures on same shaft yet no larger than reg. aircraft generator. Ideal for home, farm & shop lighting plants by hooking wires to AC side which will give 1200 watts. DC side can be used for charging batteries, welding & operating war surplus low voltage hobby motors & equipment. Also in kit: 1 Voltage Regulator DC. 1 Voltage Regulator AC. 1 Reverse Current Relay. 1 Ammeter and Shunt. 1 Voltmeter, 0 to 30 Volts. 1 Rheostat. 1 Electrode Holder. 1 Giant Toggle Switch. Welder's Shield. Wiring diagram for hookup as welder. Wt. under 100 lbs. Approx. GOVT. COST $600. Kit, **$39.95.**
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R1 GENERATOR KIT Jack & Heintz or GE. Rated 300 Amps. 24-32 Volts. With same items as above incl. 300 Amp Ammeter. Approx. GOVT. COST for kit $600. Complete kit only **$39.95.** Wt. 60 lbs.

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RUSSIAN workers are taking showers in huts like this. Water passes through 14 pipes in the panel to the overhead tank. The sun's heat, retained within the black interior of the glass-covered case, warms the water in the pipes, the Russians say, even in cold weather.

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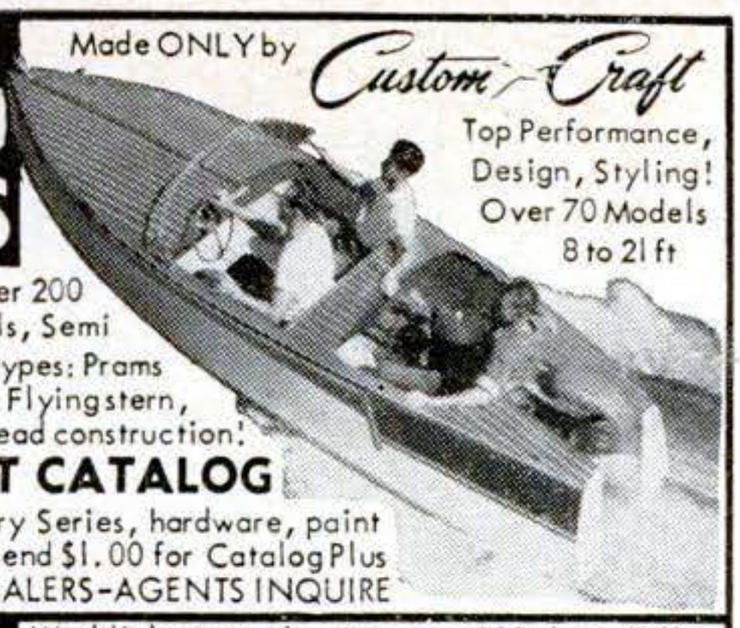

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NOW turns the ordinary shop drill into HIGH SPEED DRILL PRESS at a big saving. When DRILLMASTER is used on a 5,000 rpm drill press its top speed will be 20,000 rpm. Does the work of expensive high speed drill presses on brass, aluminum, plastics and cast iron where high speed drilling is necessary. Available for work of any size runs. Fits any ½" chuck, holding drills from 5/32 to #80. Shafts are heat treated and ground. Ball bearings and oil impregnated bearings and gear train are housed in cast aluminum. Precision made throughout. MAIL ORDER TODAY only..... **$62.50** Fob. Chgo.

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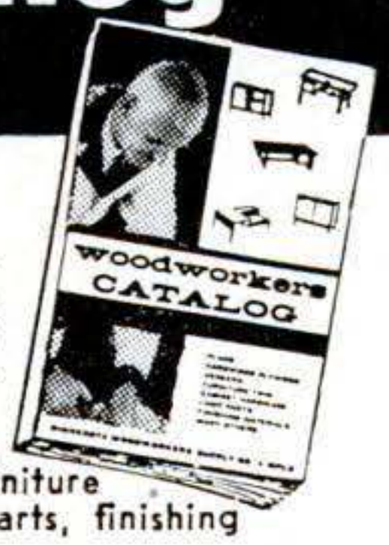

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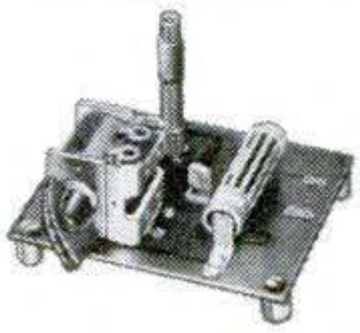
KNIGHT-KITS are famous for their clear "step-and-chek" instructions. You'll marvel at how easy they are to assemble. You'll be thrilled with their performance—proud of your work. You can't miss—and you save money!



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Experiment with the marvel of transistors! Printed circuit mounting board simplifies assembly—just make a few solder connections. Delivers fine broadcast reception. Fits in palm of your hand; powered by penlight cell that lasts for months. Complete with all parts, transistor, penlight cell. Shpg. wt., 2 lbs. **$4.35**

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Thrilling new bandswitching receiver. Selects exciting short wave on 6 to 18 mc (foreign, amateur, aircraft, police, marine); and full regular broadcast. Sensitive regenerative circuit; 4" PM speaker; beam-power output. Easy to build. All parts supplied (less cabinet). 4½ lbs. **$15.95**

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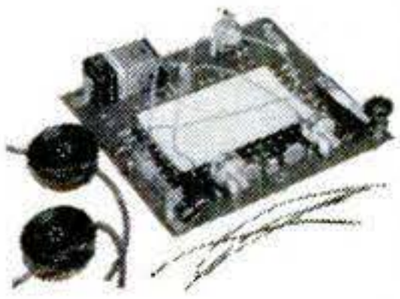

Transistorized Electronic 10-in-1 Lab Kit

Sensational—work with transistors! Assemble the basic parts, then complete project after exciting project (10 of them in all) just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio, amplifier, wireless broadcaster, code practice oscillator, electronic timer, switch, flasher, or any of 3 other electronic relays. Includes all parts, 2 transistors, battery, headphones and instructions for each project. Shpg. wt., 3 lbs. **$15.45**

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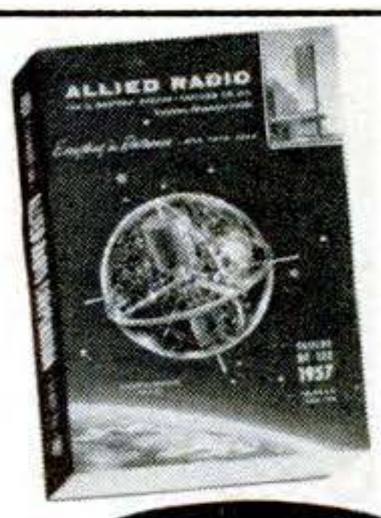

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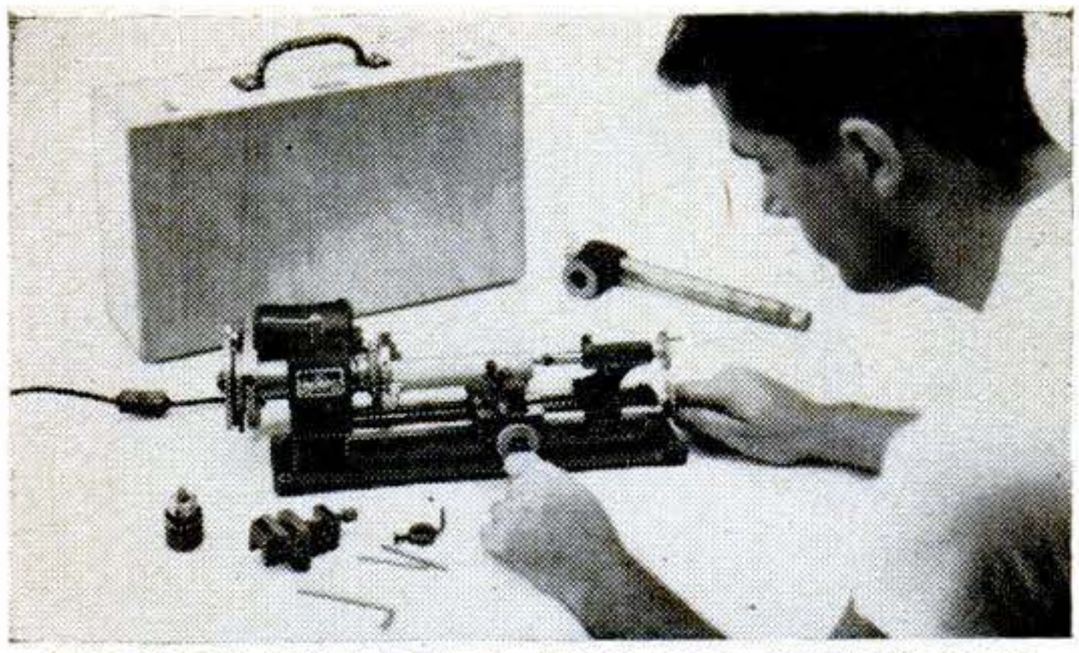


UNIMAT 10 IN 1 COMPLETE WORKSHOP

CRAFTSMEN, MODEL BUILDERS, HOBBYISTS AND INVENTORS all over the world are choosing this unique and extremely versatile electric tool for machining small parts from steel, brass, wood, aluminum and plastics. Highly acclaimed because of its precision results, UNIMAT offers these serious craftsmen many other worthwhile advantages.

UNIMAT BASIC UNIT (shown) INCLUDES: 1–a Precision Lathe and all accessories necessary to convert it quickly and easily into a 2–Drill Press; 3–Hand Drill; 4–Polishing Grinding Machine; 5–Tool Grinding Machine; 6–Milling Machine. With the Basic Unit you also get these 13 accessories Free: AC/DC Power Motor, with reduction pulleys (11 speeds–375 R.P.M. to 9200 R.P.M.), self-centering universal three-jaw "Cushman" lathe chuck with reversible jaws (abt 2½" Dia.), ¼" Drill Chuck, Pivoting Tool Holder, Grindstone Holder, Lathe Dog, Face Plate, 2 centers, Allen Wrench, Easy-to-follow instruction manual, all packed in sturdy wood veneer carrying case!

ADDITIONAL ATTACHMENTS are available for further versatility of your Basic Unit: 7–The Jig Saw; 8–Threading Attachment; 9–Circular Saw; 10–Indexing and Dividing Attachment. All attachments can be ordered individually with the Basic Unit, or at any time. (Attachments not shown.)

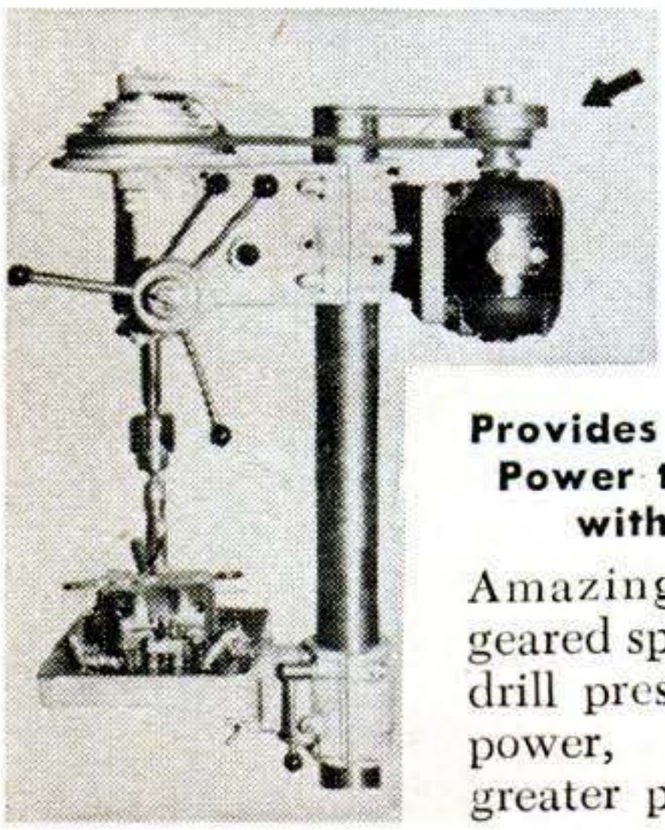
PORTABLE AND COMPACT–two more reasons for its great popularity. All operations require little working space and are performed on just one base. There is also high quality built into this unique machine tool. The ball-bearing headstock spindle has a ¼" 0 center. It also features a built-in rack, so that the headstock spindle can be adjusted 1" in either direction. This feature gives the drill press its stroke when in the upright position. The tailstock is threaded and will take either lathe or drill chuck. Constructed of high quality hardened and ground steel and a cast iron ribbed lathe bed, UNIMAT adds up to a top-notch machine tool that will enable you to create a limitless variety of objects–from just about any kind of stock material.

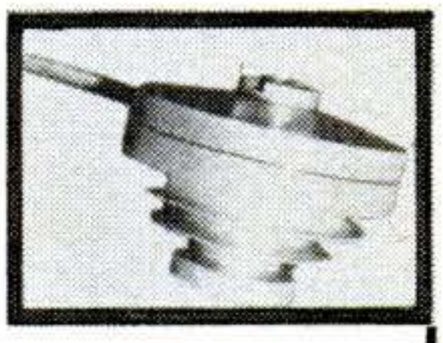
UNIMAT BASIC UNIT COSTS ONLY $99.50 and can be obtained on a budget plan for as little as $49.50 down, and $10 a month for 5 months. There's no charge for this service. It is shipped prepaid East of the Mississippi. West thereof, a slight charge is necessary. Additional literature is also available for only 10¢ to cover mailing costs. Look into this amazing precision tool today. It will prove worth your while.

Mail your order today to Dept. PS-17. Dealer Inquiries Invited!

AMERICAN EDELSTAAL (AMSTERDAM) INC.
350 Broadway, New York 13, N. Y.

New **"PULL-GEAR" SPEED-REDUCING PULLEY**





Provides Correct Speed and Power to Drill Up to 1⅜" with ½ H.P. Motor

Amazing new internally geared speed reducer doubles drill press capacity. Greater power, greater efficiency, greater productivity.

Provides the correct speed and power for larger drilling, reaming, tapping and boring on light presses. Easily installed in five minutes. Adaptable to all type machines. Spindle speed range approx. 45 to 3000 RPM. Made in 3 motor shaft sizes: ½"–⅝"–¾". Write for literature.

WRITE FOR LITERATURE

THE PULL-GEAR CO.
25429 Mound Road
Center Line, Michigan

The Light That Won't Burn Out

[Continued from page 117]

syllable scientific name: electroluminescence. Credit for its discovery goes to a French scientist, Georges Destriau. In 1936 he built a crude electronic lamp (one ingredient was sea water), noticed a faint glimmer, and published his report in a scientific journal.

Things really got going, though, after the war, when science-angled-for-profit took over. At the Lighting Division of Sylvania, in Salem, Mass., nobody had ever heard of Destriau. But Chief Engineer Howard Biggs was thinking, as a good chief engineer should, of new products his company could make—and sell.

Biggs is an expert on semiconductors, the solid crystals that do the rectifying and amplifying jobs usually associated with vacuum tubes. One day Biggs walked into the office of his manager of research, Dr. E. F. Lowry, and as Dr. Lowry now recalls, said:

"Look, Doc. There're just two ways to make light. There ought to be another way. A better way. Maybe a semiconductor light. Let's see if we can find it."

Sylvania's researchers went into action. They built a few luminous condensers—weak ones, just visible in a dark room. But within a few years, they had increased the light output nearly 1,000 times, and production began.

Sylvania has now sold about 200,000 electronic lamps—strictly on the basis that they do a particular illumination job better and cheaper than any other light source can. Besides the clock and radio dials, you should soon see electronically lit telephone and thermometer dials, switch plates, night lights and airplane fasten-your-seatbelt signs.

Other electrical firms—RCA, GE, Philips in Holland—are interested, too. Westinghouse, in particular, has pushed research in this field.

When can you expect the brighter, more efficient room lamps that will make luminous ceilings and walls? Two years, perhaps five years. The experts agree that a major breakthrough is needed—and will come. END

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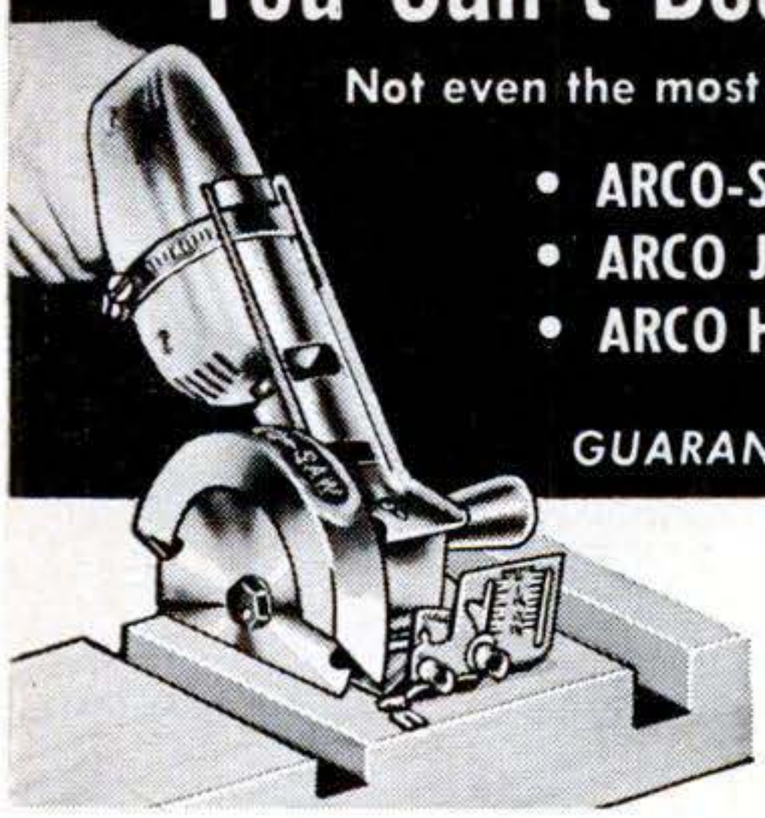
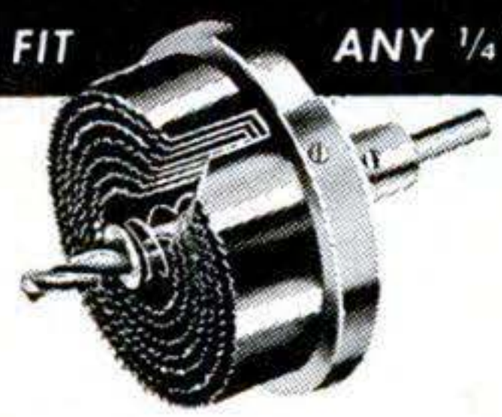
You Can't Beat these 3 POWER TOOL VALUES!

Not even the most expensive saws give you these important *extra* features:

- **ARCO-SAW:** Exclusive **Dado Arbor** cuts any groove.
- **ARCO JIG-SAW:** Exclusive **Circle-Cutter & Rip Gage.**
- **ARCO HOLE-SAW:** Exclusive Automatic **Slug Ejector.**

GUARANTEED TO FIT ANY ¼" DRILL





"ARCO-SAW" rips & crosscuts up to 2" board. "Dado-Arbor" adjusts for cutting grooves up to ½" wide x 1" deep in 1 cut! **Not even a $100 portable saw has a dado cutter!** Graduated gages for ripping, depth & angle cuts. Safety-Yoke permits one hand operation. Incl. 5" blade.....**$12.95**
Blades 5" Rip, X-cut, or Comb.....**$1.75**

"ARCO HOLE-SAW" 7 saws in 1. Cuts 1", 1¼", 1½", 1¾", 2", 2¼", 2½" holes in wood, formica, metals. Fits any drill, drill press, lathe. New "Slug-Ejector" pops out discs—works 3-times faster than others **selling** for twice as much! Incl. ¼" drill bit **$6.95**
4 Blade Model cuts 1", 1½", 2", 2½" **$4.95**

"ARCO JIG-SAW" with adjustable Circle-Cutter & Rip Gage cuts perfect circles up to 20" diam., rips accurately. Cuts intricate patterns in wood, metals, plastics—even zips thru 2x4's! Starts inside holes. **Has same capacity as $55 jig saws!** "Air Jet" blows away sawdust. Incl. blade.....**$10.95**
6 Blades for wood, plastics, metals...**$1.95**

first in drill ARCO attachments

Sold at Better Hardware Stores Everywhere or order direct on our **UNCONDITIONAL 10-DAY MONEY BACK GUARANTEE.** Send check, M.O. (ppd). C.O.D. plus post.

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Automatic Saw Set...

MAKE EXTRA PROFITS!

Set 400 teeth per minute on hand or band saws, 4 to 16 point, with the BeMaCo Automatic Saw Set. Fast, accurate, true **hammer-anvil action** sets teeth uniformly, eliminates tooth breakage. Used profitably by saw shops and manufacturers everywhere. Every machine positively guaranteed!

Write for details—today!

Saw Machine Division 26-S

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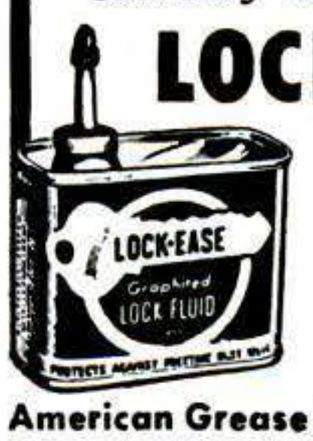

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EASY TERMS ONLY $98.50 F. O. B.

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Write today for the new 16 page booklet... "Things You Should Know About Hand Saws". It's free - Dept. PS.

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BUY at dealer's prices direct from MASTER MECHANIC factory!

PIPE STRAP WRENCH—A must for every professional and home mechanic—this unusual strap wrench grips pipes and large fittings vise tight yet handles them like a kid glove! Ends all marring and slipping when tightening polished or chrome pipes. Also ideal for use on sink trap slip nuts,, extra large unions, fittings, etc. where ordinary wrenches are not large enough. Big 12" long handle gives good leverage for easy operation. Equipped with 1¼" x 24" heavy web strap and adjustable clip which draws strap tight. (Item 383c). Wt. 3 lbs. Regular $2.95 value, Our special only.. **$1.95**

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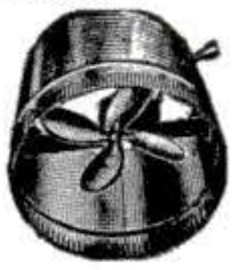

(Item 10) Easily installed in furnace pipes. Forces even heat to all rooms. Over range removes kitchen smoke and odors. Powerful, continuous duty motor, 110-120 v. AC. Mount in wall or ceiling to ventilate any area. Quiet, super-efficient fan moves huge volume of air. (400 to 600 CFM).

8" Pipe, wt. 5 lb. **$6.85**
9" Pipe, wt. 6 lb. **$7.85**
10" Pipe, wt. 7 lb. **$8.85**
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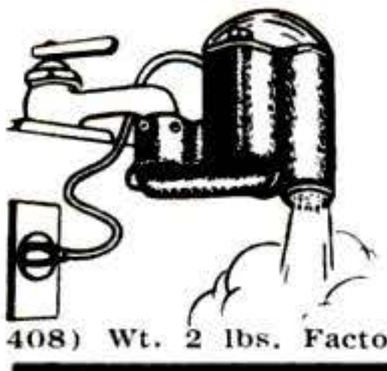
HEAVY DUTY FAN. Semi-enclosed motor, suitable for spray booths, restaurant exhausts, poultry houses, etc.
10" Fan, wt. 8 lbs. (Item 10E) **$11.95**
12" Fan, wt. 10 lbs. (Item 10D) **$12.95**

HIGH SPEED BARN FAN similar to above, but larger, high speed motor moves huge volume of air.
12" Fan (Item 10f) **$14.95**
14" Fan (Item 10g) **$17.95**



FAUCET WATER HEATER

Instant hot water from any faucet for just pennies—sounds unbelievable—but it's true! You just slip MASTER MECHANIC'S new Faucet Water Heater over any water faucet, plug it in a wall outlet and you've got hot running water *instantly* for dishes, shaving, washing baby's bottle, etc. Simple and safe—operates on ordinary 110 v. house current—costs only 2½ cents per hour for hot water. Ideal for homes, barns, cabins, trailers, etc. Easily regulated from lukewarm to full hot. Fully guaranteed! (Item 408) Wt. 2 lbs. Factory price F.O.B. Burlington, only..... **$4.95**

Send check or M.O. Prices f.o.b. Factory. 10 day Money back guarantee.
MASTER MECHANIC MFG. CO., DEPT. 76-P Burlington, Wis.
SEND 10c for BIG 1957 Catalog

Night Raid in Our Hydrogen Bomber

[Continued from page 102]

lessly out of the fight. To make matters even worse for the interceptor, the B-52 carries a new four-gun tail turret that tracks an attacker automatically and sprays him with a hail of 50-caliber bullets.

However, if the big bomber gets into serious trouble, the crew can go, go, go—no sweat. The pilot, copilot and Electronic Counter Measures operator eject upward; the navigator and observer eject downward; and the tailgunner fires off his turret and dives after it.

Another fact worth noting: The B-52 holds the world's record for a fast big-plane let-down—a screaming 25,000 feet per minute. That's only two minutes from bombing altitude down to the deck.

The big airplane is also a dream in a crosswind. Its wheels swivel. You head the airplane directly into the wind. It settles at what appears to be a suicidal crabbing angle. But it's not suicide at all. The wheels, being lined up with the runway, roll her on like a kiddie car, and since this airplane costs us taxpayers $8,000,000, we ought to be happy. A ground loop could wipe out every nickel of it in a split second. But despite its 200 tons fully loaded, the B-52 flies like an overgrown Cub.

You steer it with the rudder. As you gain speed, the droopy wings perk up like the wings of a bird. You ease off, tuck the wheels and flaps away in their slots, and go on up where there's scarcely any air at all. Above 45,000 feet, the MC-1 pressure suit is a must. An explosive decompression above that height could kill you in ordinary gear (although some rugged pilots have rolled over and dived vertically to safety after "blowing out" at 50,000). Pressure breathing is just the reverse of ordinary breathing. The suit punches air into your lungs. You force it out—and it takes a lot of forcing! Ten minutes is all the average healthy man can handle.

A set of metal fingers control the B-52's flight near the ground. Called

[Continued on page 260]

NEW! LET YOUR DRILL SHARPEN ITS OWN BITS

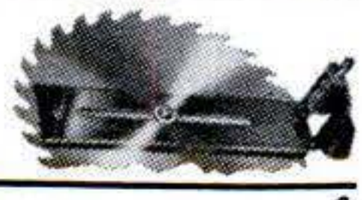
Grinds round shank drills from 3/32" to ½" like new in 4 drill point angles. Fits all portable drills; converts drill motor to bench grinder. Complete Kit No. 32 includes stand, sharpener, drill clamp, 4" grinding wheel, arbor ..... **$8.95 PPD.**

Sharpening Attachment only.....$2.95 PPD.

SAW SHARPENING IS EASY

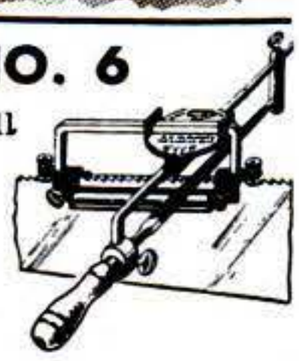
Super Filer No. 11 joints and sharpens hand and circular saws 6" to 10" with all teeth correct in height, depth, pitch, bevel. When file hits steel roller teeth are finished. Saw runs true with no side pull. Includes 8" file..... **$9.95 PPD.**

TRU-CIRCLE saw set automatically sets teeth at 10° or more. **$2.95 PPD.**



NEW! SUPER SAW FILER NO. 6

Automatically controls depth, angle, pitch for all saws. Precision made and calibrated. Use in any vise or clamp. Includes file. **$6.50 PPD.**



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At Your Favorite
Hardware & Lumber Supply Store

A product of Southern Screw Co.
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SAVES PLUMBING BILLS

CLEANS INSTANTLY

CHICAGO—Jan. 1st—Home Owners, Offices, Apartments, including Factories are constantly having trouble with clogged-up pipes which proves expensive in Costly Plumbing Bills—

But now—using Water Impact and Air Pressure, here is a new unit called the **Plumber's Flushing Gun,** which cleans all lines up to 100 ft. It will open any number of bends in pipe. Yet anyone can operate this new gun, which triggers easily.

TOILETS, URINALS, SINKS, and FLOOR DRAINS clogged with paper, grease, rags, sand, and other debris can be cleared with one or more shots from the gun, **saving the owner, the Gun's price the first time it is used.** This new Flushing Gun may be used on any ½ to 6 inch waste pipe including Sink Drains, Floor Drains, Hot Water Pipes, Drinking Fountains, Septic Tanks, and Urinals. Obstructions melt away INSTANTLY when struck by the hammer like blow of this new unit.

This New Flushing Gun is offered on 30 Days Free Trial. BUT MOST IMPORTANT IS THIS—What is this Tool worth in **Costly Plumbing Bills** Saved in your Home or building. For your own good—Tear this Ad out now and write your name and address beside Ad for **FREE BOOKLET.** No agent will call—Obey that urge, mail now or write postcard. (Chicago Phone Kildare 5-1702) **MILLER SEWER TOOLS, DEPT. P.S., 4636 N. CENTRAL AVE., CHICAGO 30, ILLINOIS.**

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Countless decorative uses too; trim lamp shades and picture frames, decorate coffee tables, clocks, waste baskets, etc.

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USE THIS ONE LOW-COST MACHINE for Planing, Jointing, Sawing, Milling, Tongue and Groove.

You can easily make flooring, siding and many other popular patterns with your Belsaw. Your Belsaw quickly pays for itself with savings on raw materials and profits on finished stock . . . a highly profitable machine for custom work. Compare Belsaw with any 12-inch planer on the market... Belsaw gives you more essential features—yet costs you $50 to $125 less than others.

Send Today for Free Literature on the Belsaw Multi-Duty Planer.

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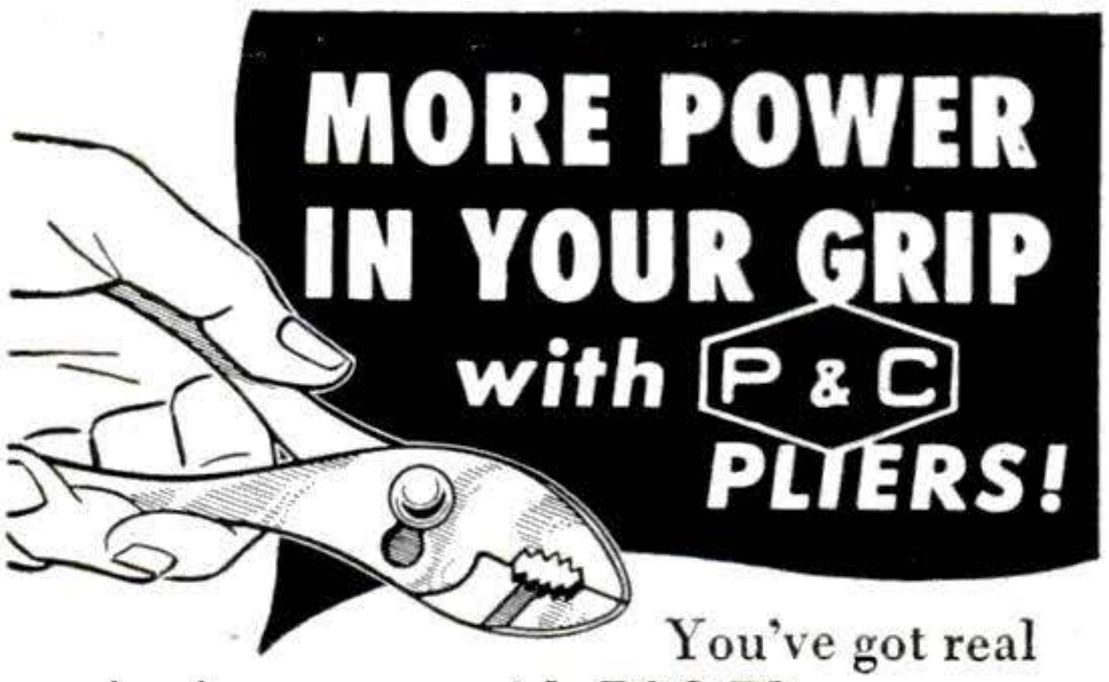

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Enclosed find 25c. Rush WOODWORKERS' CATALOG.
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Night Raid in Our Hydrogen Bomber

[Continued from page 258]

"flaperons," they ripple up out of the top surfaces of each wing in response to the yoke. The flaperons dirty up the top of the wing, spoil its lift, and make it sag down into a bank. Retracted, they clean up the wing and restore its lift, and it either stabilizes or rises again, depending on the yoke pressure. For high-speed cruising, at altitude, the B-52 is banked by little stubs of ailerons, sandwiched between its huge flaps. These stubs are too small to be effective at low speeds—hence flaperons.

Older bombers used to carry their breathing oxygen in bulky steel bottles. Not so the B-52. It uses small refrigerators and stocks liquid oxygen, making possible great weight savings and a vastly larger amount of breathing gas (since a few jiggers of liquid can fill a mighty large gas volume when allowed to expand).

The thing that impressed me most about the B-52 was its little need for maintenance. The old B-36s were being worked on by hordes of mechanics from the moment they landed until they took off for the next mission. All Wright's crewmen did—honest!—was wipe the windshields and help fire up the engines. And yet, if the aluminum skin had been peeled off those B-52s, the complication of gadgetry revealed would have made Rube Goldberg dizzy. The B-52 is literally crammed with wiring, motors, turbines, pumps, generators, tubes, linkages, fuel cells, ammunition, electronics and thousands of other items too technical to describe.

Every available inch of volume is packed solidly—and most of those myriads of gadgets have got to function properly if the bomber hopes to operate at top efficiency. The power for the internal systems is supplied by four pneumatic packs that bleed ram air from the engines, duct it to high-speed turbines, and transform it into electricity. Boeing has bent over backwards to give the crew a break. Only two of the four power

[Continued on page 262]

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IN SHEET METAL, WOOD, ANGLE IRON, TRANSITE, BAKELITE, etc.

Fits any ¼" or ½" electric drill or drill press

Drills own ¼" starter hole; cuts straight, curves, or angles. Made of finest High Speed, abrasion-resistant steel. Easy to use.

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Check or Money Order **INTERNATIONAL TWIST DRILL CORP.**
DEPT. 1-$ 618 Wyandotte, Kansas City, Mo.

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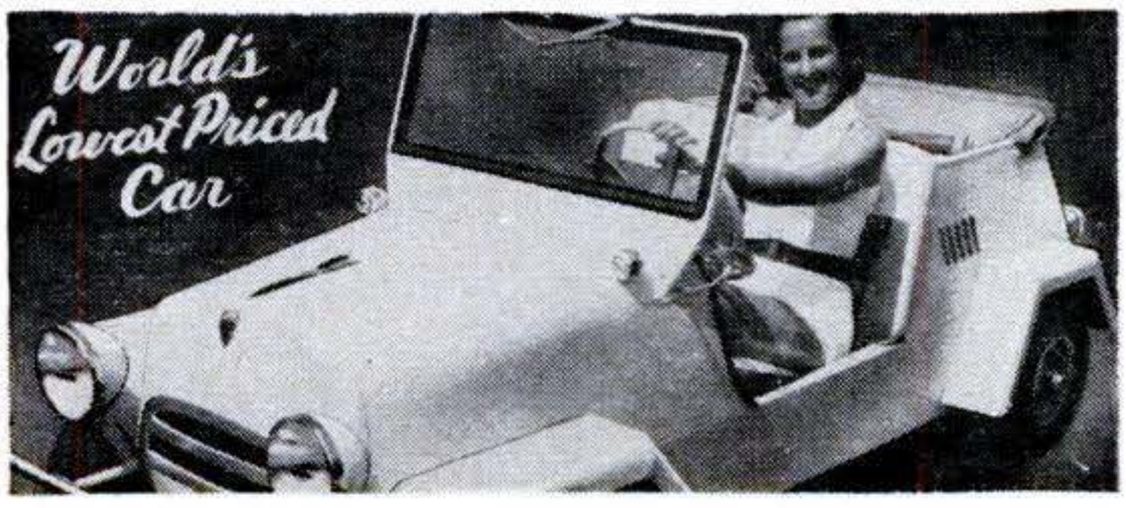
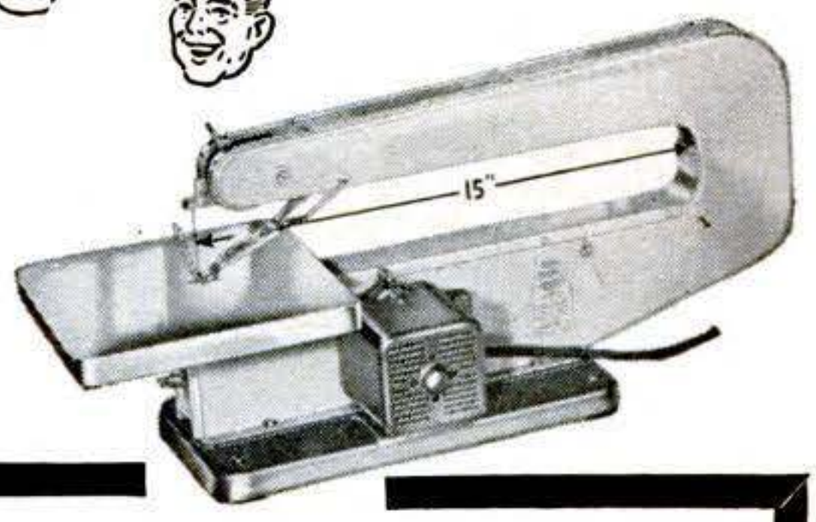


ELECTRIC DREMEL POWER TOOLS

DREMEL MOTO-JIG SAW



Family Fun Starts Here!

Woodworking is a *happy family hobby,* with a Dremel Moto-Jig Saw. You don't need special skills. A card table can be your workbench.

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Write for FREE folder describing 8 new pattern packets of fun-to-make jig saw projects and new power tool catalog.

Model 15 15" throat . . . . . **$29.95** **Model 8** 8" throat **$23.50**

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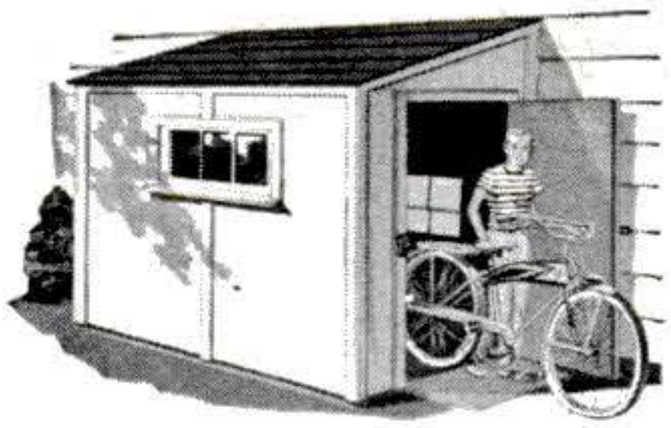

and dozens of other worthwhile things for your home—at one-third normal cost!

You never know your capabilities until you try. For thousands of people like you, Easi-Bild* has opened a whole new world of fun, satisfaction, and proud possession. You work from *patterns*—not from blueprints—and you get professional results.

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Proper **know-how** makes it easy—the **know-how** of Easi-Bild Patterns and the Homasote Handbook. Whether it's a valance-bookcase, a swing-up garage door, or a one-room guest house, your *only* cost when you make it yourself with Easi-Bild Patterns is the cost of materials—just *one-third* normal cost. Look for this emblem on your lumber dealer's counter—and use the coupon to get your free copy of the 68-page Homasote Handbook.

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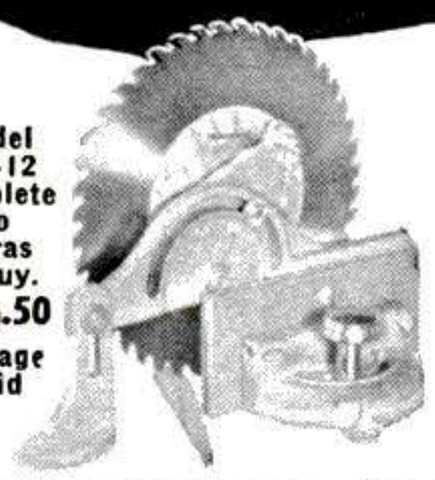

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QUICK-WAY SAW CO., 134 Tompkins St., Cortland, N.Y.

Night Raid in Our Hydrogen Bomber

[*Continued from page 260*]

packs are needed to complete a mission. The other two are life insurance. This 100 percent margin of safety is carried right through the design of the airplane. She can take a terrible beating and still fly home.

Six hours after Wright taxied out for takeoff on that first night, and roared away in the starlit sky, we stood in the flight line in the dawn waiting to greet the returning fliers. They had made a 3,100-mile loop around the eastern part of the United States. We were surprised to find the area jammed with happy, excited people—the mechanics, sympathizers and interested officers and men connected with the 42nd Bomb Wing, for which Wright was flying. The onlookers wasted no time in passing the big news. Capt. Maushart, while he had not hit St. Francisville on the noggin, had acquitted himself very handsomely indeed. But Bob Townley had done the impossible. He'd shacked Springfield, in Yankeeland, just as he'd hoped. His "bomb" had landed fairly and squarely on the northeast corner of a six-story warehouse—not a foot off the aiming point! At this moment, Wright's crew was leading the entire competition in the bombing category.

That first mission was not a fluke, it is a pleasure to report. Townley kept twisting his tracking handle with authority all through the meet. He ended by beating the other three B-52s—plus 34 of the other 40 airplanes in the "world series"—to take fifth in bombing for the meet. He was the only B-52 bombardier to get a shack.

There was no longer any room for doubt. The B-52's debut had been a success. Its easy controllability at high altitudes and its efficient design had provided a stable bomb-dropping platform that enabled Linn Wright's crew to bring it in among the winners. SAC had a new bombing machine that was worth every penny of the $8,000,000, and 160,000,000 Americans could breathe a little easier in a jittery atomic world. END

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Runs on any 6 or 12 volt battery. Capacity 1000 to 2000 lbs. Holds 40 ft. cable. Use on trucks, cranes, farms, etc. Cost $280. **$46.71 F.O.B.**

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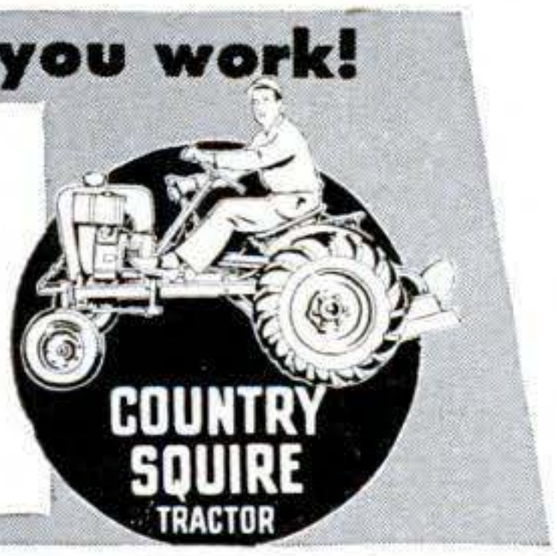

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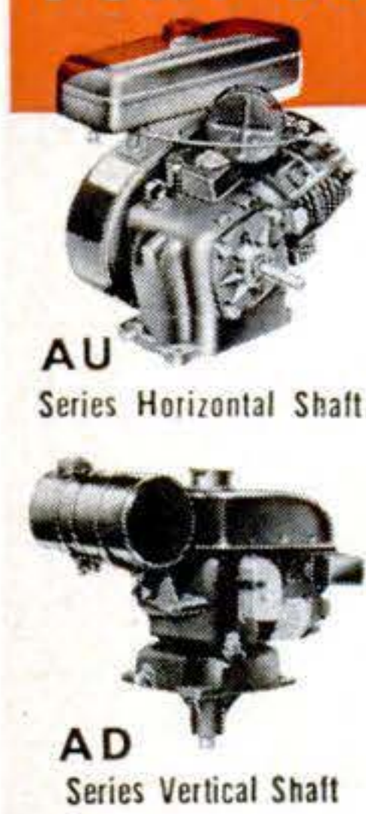

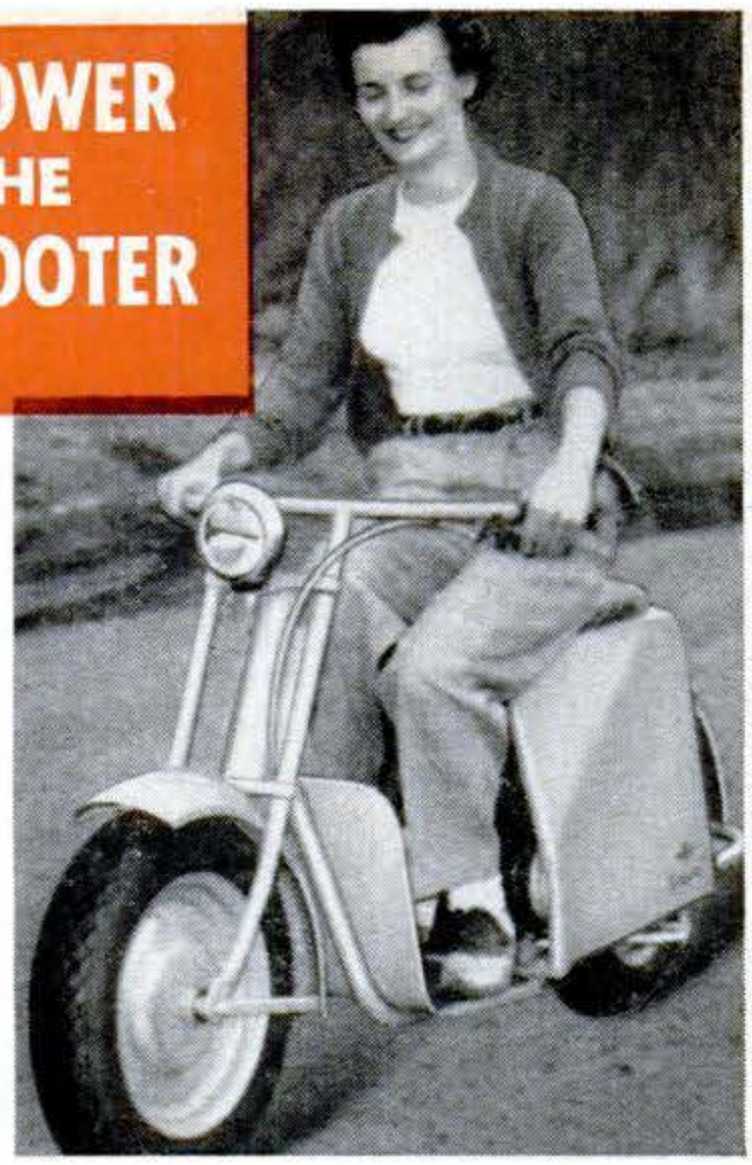

You get dependability, as well as agility, in this well-designed two-wheeler built by Hawk Tool & Engineering Co., Clarkston, Mich., and sold by Montgomery Ward & Co. It's powered by Continental Red Seal AU Series engine, equipped with built-in generator to operate its lights. It will pay you to specify Red Seal for any job within its power range.

For information, write:

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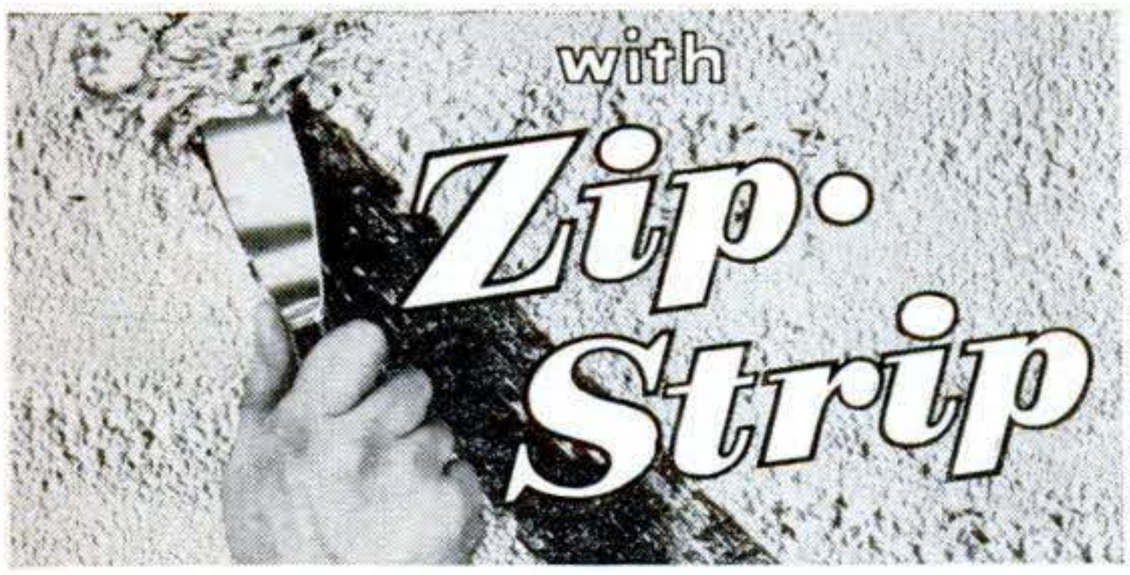

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STAR BRONZE COMPANY
ALLIANCE, OHIO

Are You Getting Too Much Sleep?

[Continued from page 114]

for hours, and wake up unrested and, muscularly speaking, stiff.

It follows that since normal sleepers move frequently, it doesn't matter what position a person goes to sleep in.

What wakes you. Persons who sleep "with one eye open" actually depend on their ears. Researchers from the Harvard Medical School and the Loomis Laboratory (Tuxedo Park, N. Y.) found that noise too light to waken a sleeper can produce a characteristic change in his brain waves, except when he is in the deepest stage of sleep. This change, called the K complex, is a series of fast waves on top of a series of slow ones.

A sleeper's own snores can bring on the K complex—and sometimes wake him up. So will turning on a light or applying a mild electric shock to his finger. But the sense of hearing stands guard better than sight or touch. In other words, the worst disturber of sleep is noise.

Measuring dreams. A man's eyes move even during sleep, a fact that is providing researchers with clues to dreams. Dr. Kleitman and associates at the University of Chicago placed electrodes around people's eyes and recorded eye movements.

They found that, as we drift off to sleep, our eyes drift, too, moving slowly from side to side—sometimes in harmony but often not. Eyes move that way every time we stir.

Periods of rapid, jerky eye movement also occur, accompanied by an increase in heart rate and respiration. Most sleepers who were awakened after a burst of such activity gave vivid descriptions of dreams; most awakened when there were no eye movements recalled no dreaming.

On the basis of these studies, dreams may last as long as an hour or as little as several minutes. In the course of a night a sleeper may have three or four periods of dreaming—or at least, rapid ocular activity—but the dreams remembered are likely to be the last ones.

[Continued on page 266]

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Also Build-it-yourself 18" Band Saw, 6" Belt Sander, Shaper, 8" Tilt-Table Saw. Simplified plans, build easily with hand tools only. Advertised and sold for 9 years, over 30,000 units in use. Money back Guarantee. FREE CATALOG.

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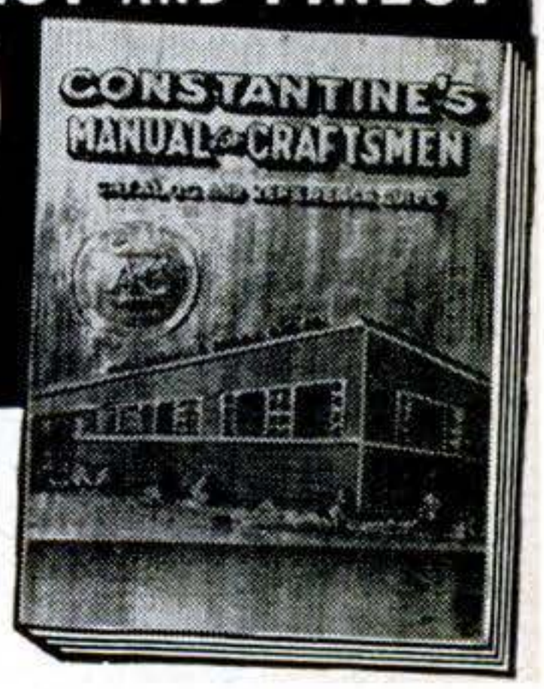

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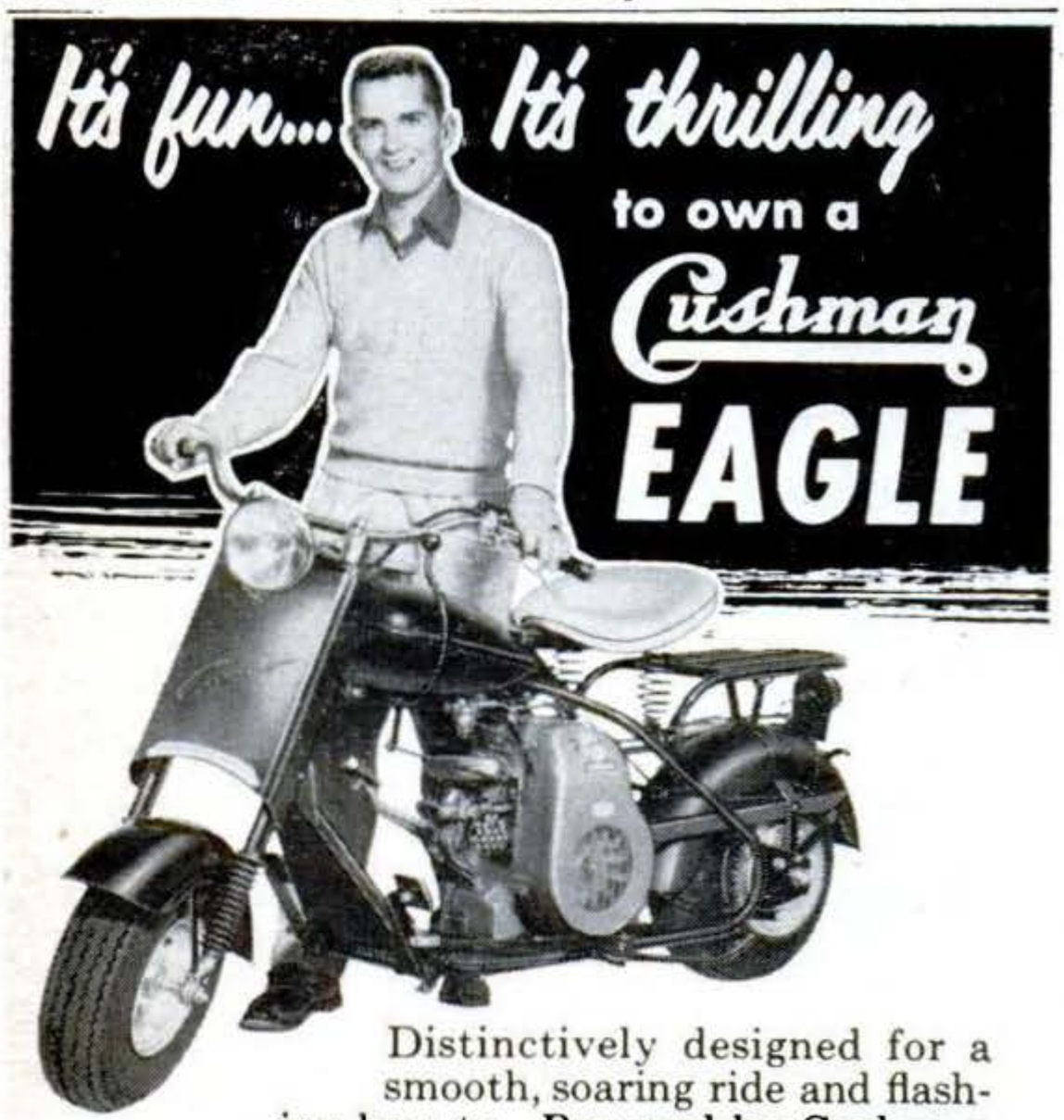

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Are You Getting Too Much Sleep?

[Continued from page 264]

When we dream, the EEG shows, we are three-fourths of the way awake.

What causes sleep? Scientists aren't sure. A Swiss physiologist inserted electrodes deep into the brains of cats—in the area called the hypothalamus—and turned on a mild electric current. The animals curled up and went to sleep. Their brain-wave patterns then became "astonishingly similar" to the third and fourth stages of human sleep. This suggests that when a "sleep center" in the older, lower part of the brain is stimulated, it closes the gateway on messages to and from the cerebral cortex, the center of consciousness.

Other scientists believe that there must be one or more centers in the same general area that keep us *awake*. Their evidence: When the connection between the cortex and the region below is cut, brain-wave patterns show sleep. Further, when certain small regions at the base of the brain are stimulated electrically, the EEG pattern shows wakefulness.

Perhaps, then, two kinds of centers are involved in the sleep-wakefulness cycle. One may shut the gate on messages from the conscious part of the mind. The other may be a collection of mechanisms, including pain, hunger and will, that open it.

Theories exploded. It was once believed that we sleep because some of the blood leaves the brain—that nerve cells, receiving less nourishment, reduce their activity. But it turns out that the amount of blood in the brain, if it changes at all during sleep, increases slightly.

Another notion was that the brain shuts down periodically under the influence of fatigue poisons. It is a fact that nerve cells tire faster than other kinds, but no sleep-producing toxin has ever been identified.

Modern theories about sleep are based on the feedback principle. When it's time to sleep, whether because of habit or fatigue, your muscles relax. The nerves controlling them send less infor-

[Continued on page 268]

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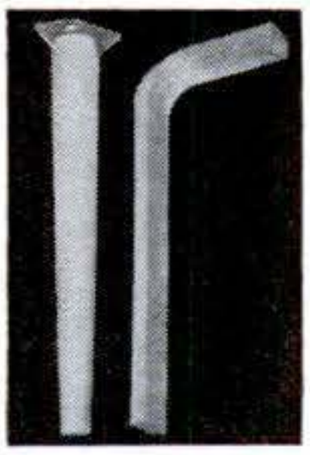

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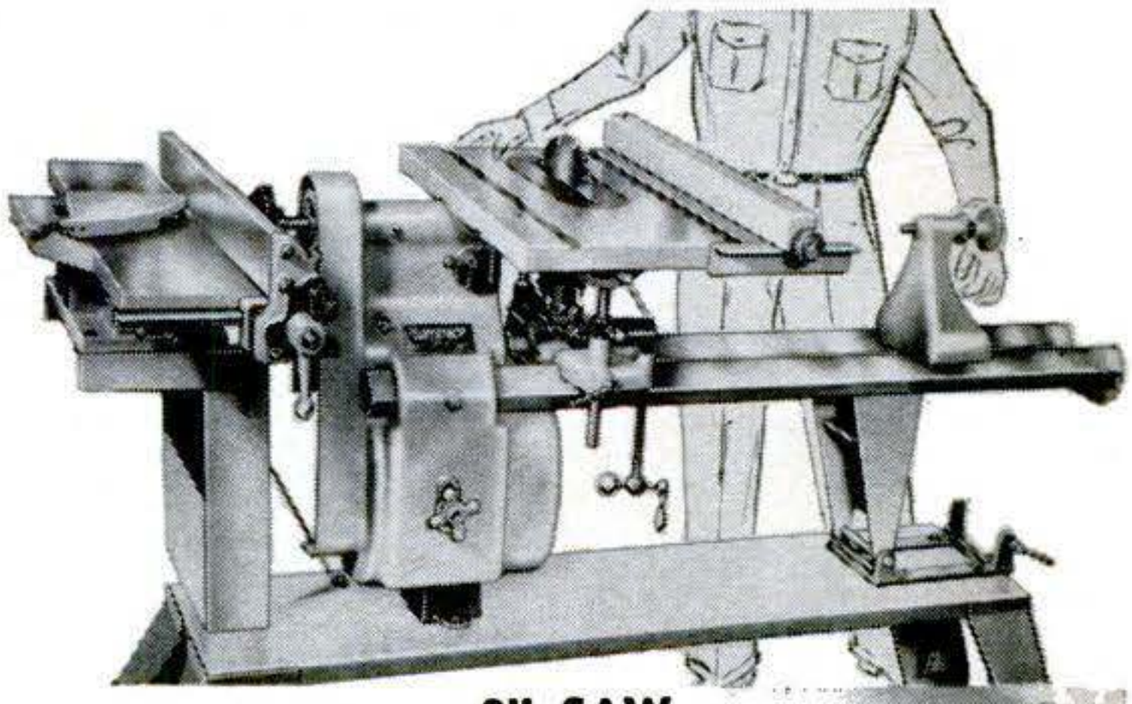

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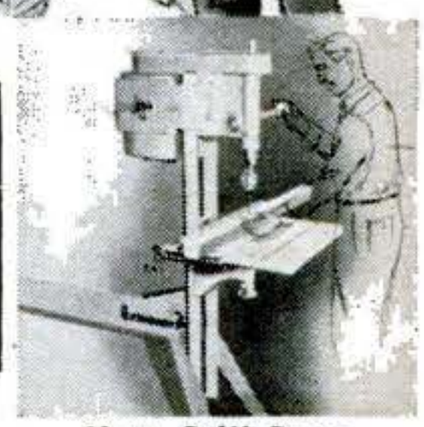

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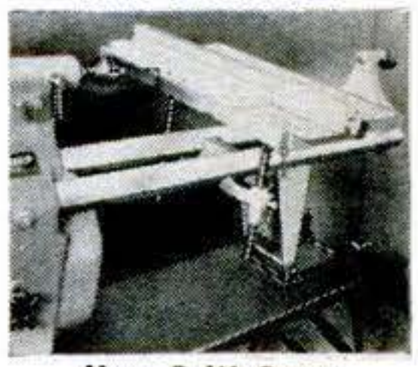

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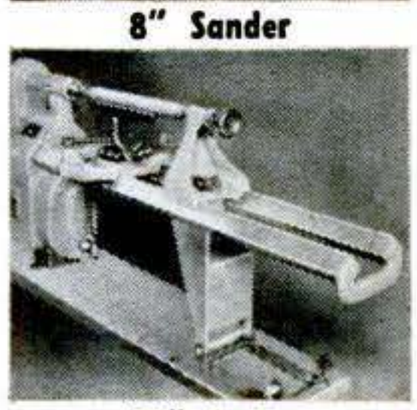

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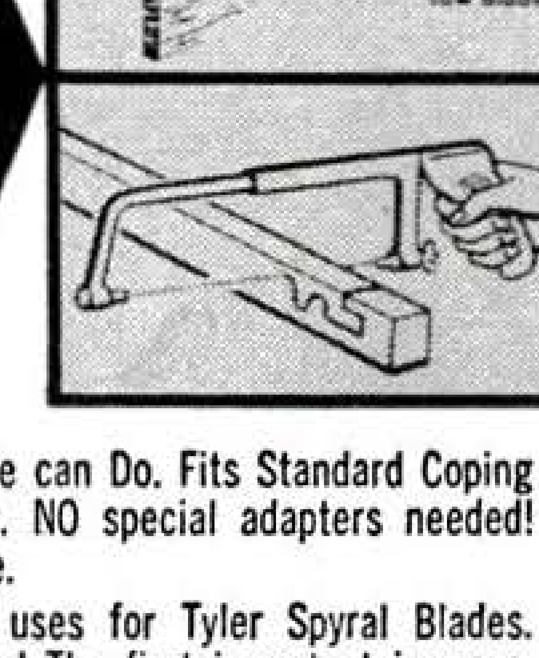

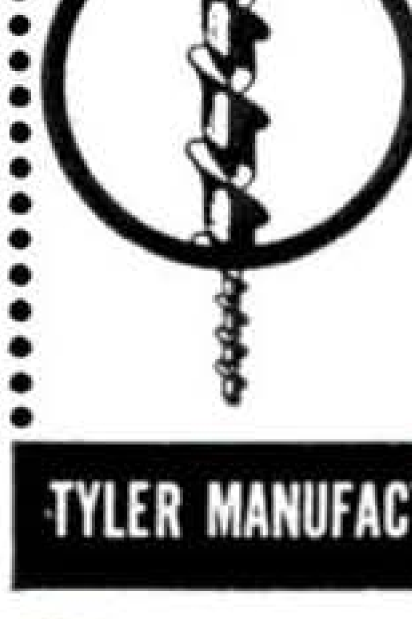

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Are You Getting Too Much Sleep?
[*Continued from page 266*]

mation to the brain, so the brain sends fewer commands to the muscles. So they relax still more, and so on. Evidence: We tend to get sleepy when we can't move around—as at a meeting—and we can stay awake several nights in a row only by keeping physically active.

If you can't sleep. Consciously relax all of your muscles. A warm bath may help. Stop mental or physical work at least an hour before bedtime. If you're the type that gets hungry every few hours, have a little something to eat or drink. Try to go to bed at the same time every night, because habit plays a tremendous part in sleeping. If you read, choose something that's easy to put down. Let your mind be at peace; prayer at bedtime can help. Imagine yourself in a situation where you habitually do go to sleep; or visualize a pleasant scene like a meadow or woodland glen.

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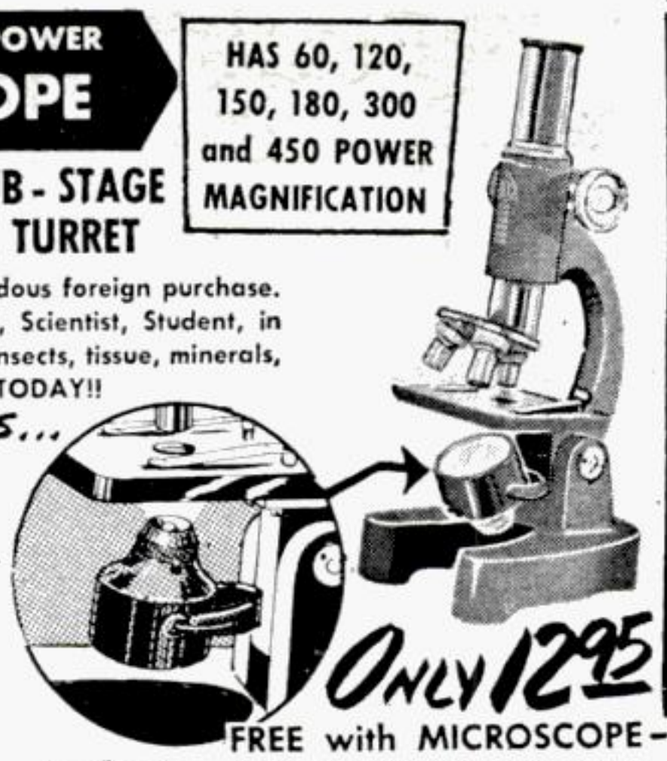

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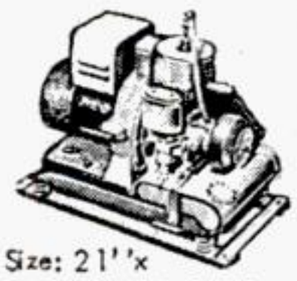

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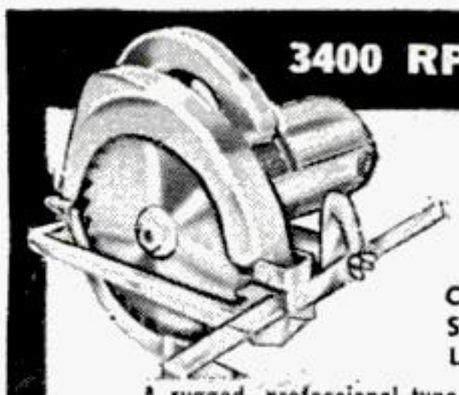

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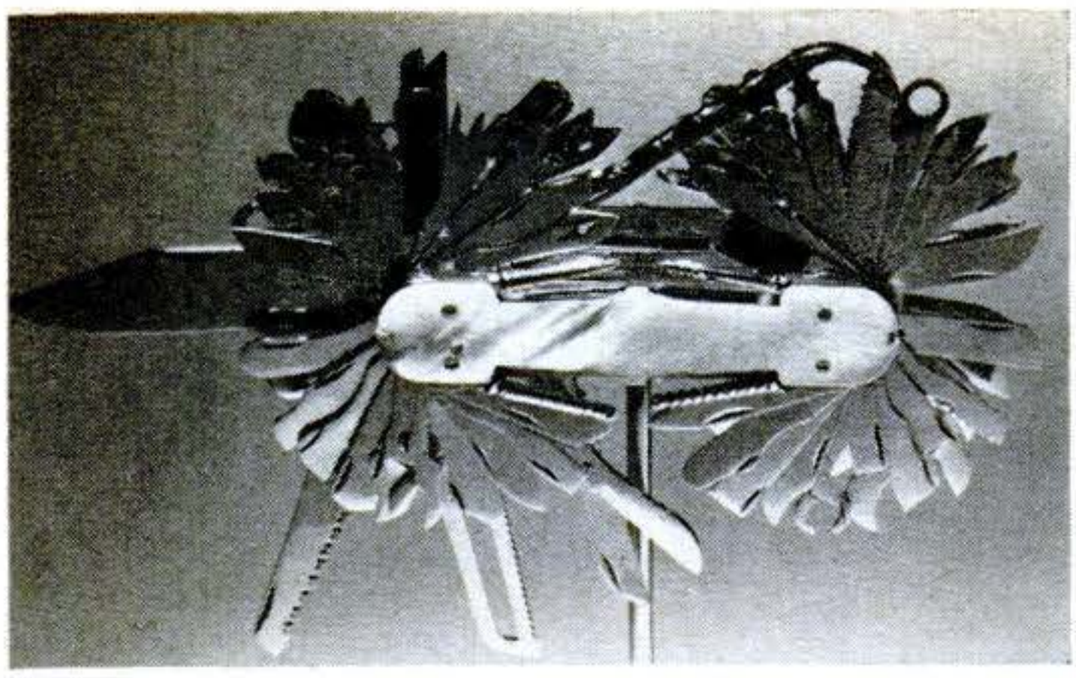
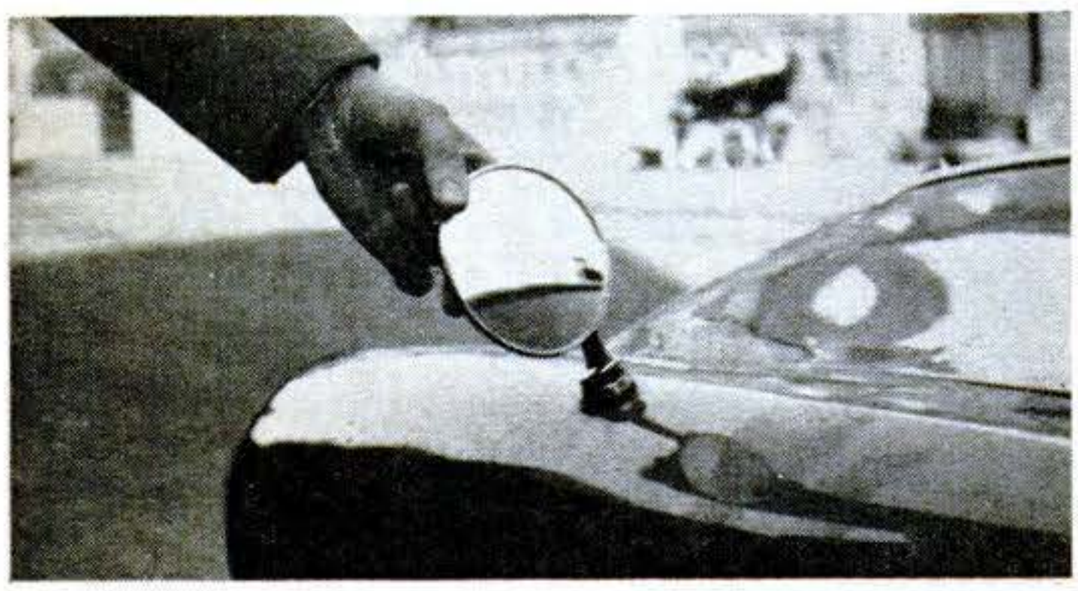


Knife Is a Gadgeteer's Dream

FOR 175 smackers, a goggle-eyed Boy Scout or an adult deer slayer can astound his fellows with this pocket knife imported from Germany. It packs away 100 blades, tools and gadgets in its pearl handle. Hoffritz for Cutlery, New York, sells it.

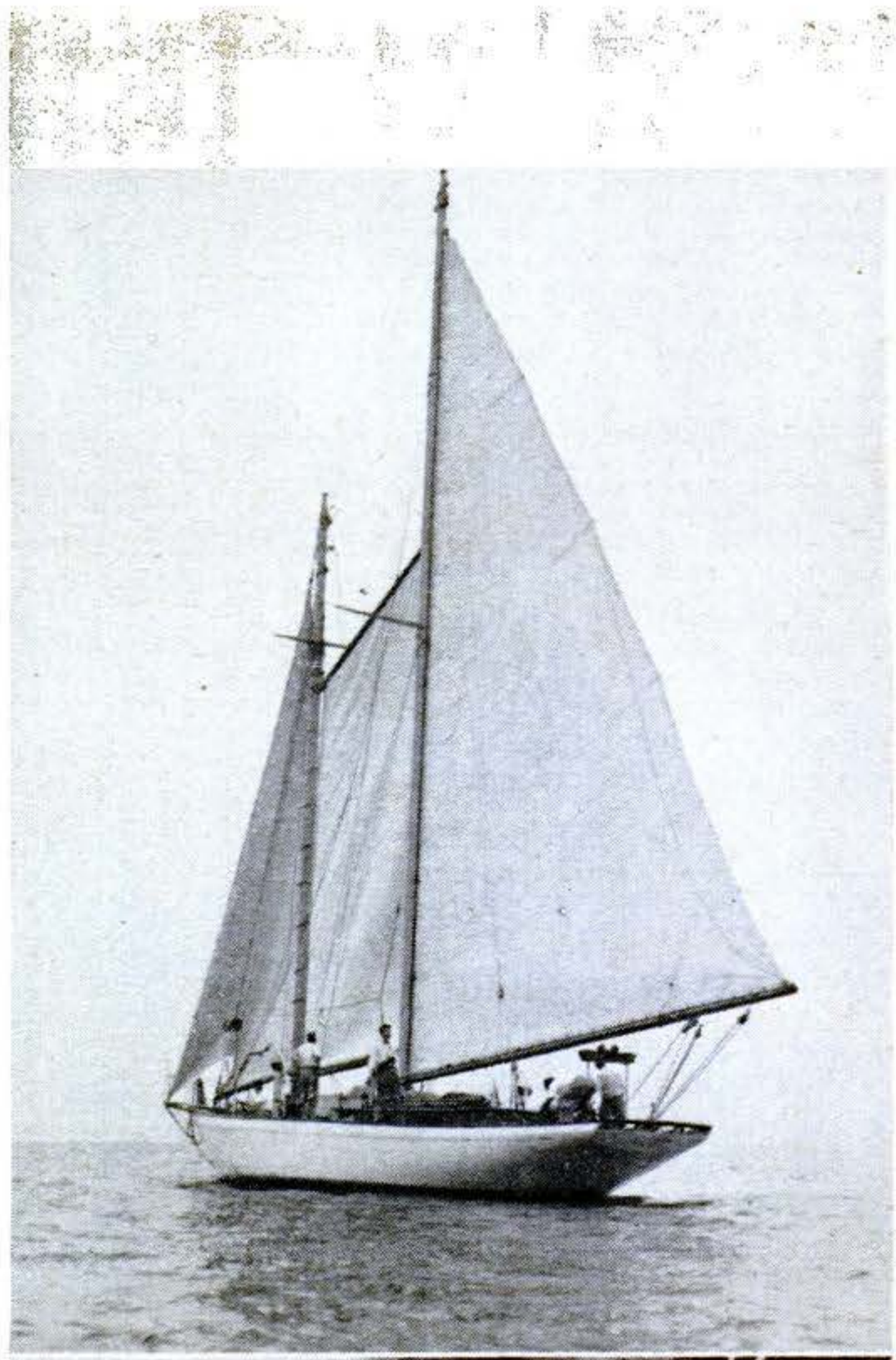


Fender Mirror Is Spring-Loaded

A NEW English fender mirror (above) springs back into position if knocked by passers-by, but even a high wind won't budge it. A ball joint and lock nut in the support let you swing the glass aside to polish the car. Magnatex, Harlington, England, makes the new accessory.

Surfaced Sub Refuels Seaplane

THE Navy's sub-hunting P5M Marlins are experimenting with submarines as refueling bases to extend their range. In the photo, a seaplane is nestled up to the USS Guavina. Inflated rubber bins form a catwalk between sub and plane.



Students Float to Classes

A FLOATING classroom and laboratory, the Action (top) will be manned by New York University oceanography professors and graduate students. In lower photo, a student lowers a pressure- and temperature-measuring bathythermograph.

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Champion spark plugs power 130 out of 134 stock car winners!

BOX SCORE OF 1956* NASCAR WINNERS

	Short track	Convertible	Grand National	Total
Ford	10	26	13	49
Chevrolet	18	10	3	31
Dodge	1	10	10	21
Chrysler	0	0	19	19
Mercury	2	0	5	7
Oldsmobile	1	0	1	2
Buick	0	1	0	1

*through Oct. 14

Tremendous record compiled by seven different makes of cars proves Champions are best for your car, too! If you've gone about 10,000 miles without a spark plug change, they can boost your road horsepower by 24%!

What could be more dramatic proof of Champions' amazing performance? Out of 134 winning stock cars in 1956 NASCAR† races, *130* were powered by Champion Spark Plugs!

This kind of performance shows that Champions are best for *your* car, too. In fact, independent engineers have proved that if you've gone about 10,000 miles without a spark plug change, new Champions can give your car an *immediate* gain in road horsepower—*a gain that averaged 24% in tests with all major makes of cars!*

If you haven't had your spark plugs checked recently, chances are you're losing power! For spark plugs should be checked every 5,000 miles—and changed every 10,000 miles—to assure maximum performance. Replace *your* old plugs with new Champions—and get more road horsepower *instantly!*

†National Association of Stock Car Auto Racing, Inc.

Cars that win stock car races are no different from the cars you drive. But the men who race them know how to get every last ounce of horsepower. That's why the overwhelming majority of winners—better than 96%—are equipped with Champion Spark Plugs.

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9″ x 3′ Model C Bench Lathe $276.00 f.o.b. factory. Time payment terms available.

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This South Bend 9″ Precision Lathe is the basic tool for your shop. It enables you to perform accurately the same full range of operations done on South Bend Lathes in industry. Also, operations ordinarily performed on other machine tools are made possible through the use of efficient attachments. You get more for your money in a South Bend 9″ Lathe.

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NEW 14″ DRILL PRESS—a ruggedly built tool unsurpassed for accuracy and dependability.

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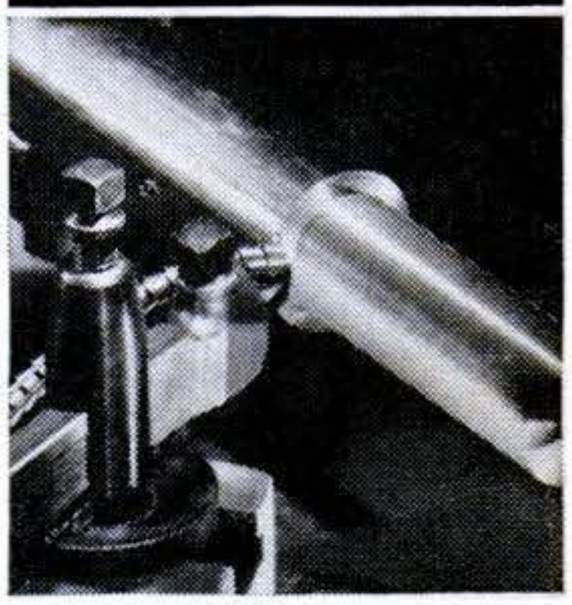
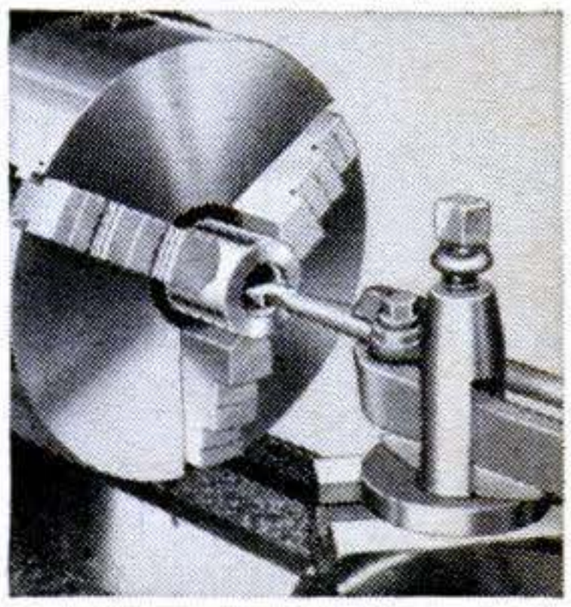
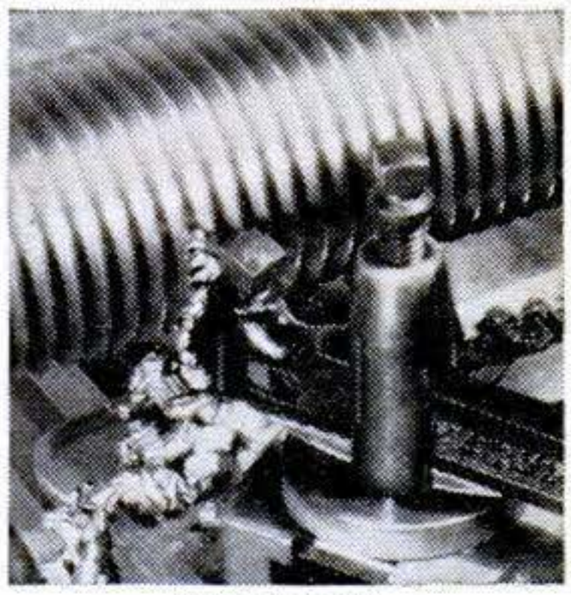


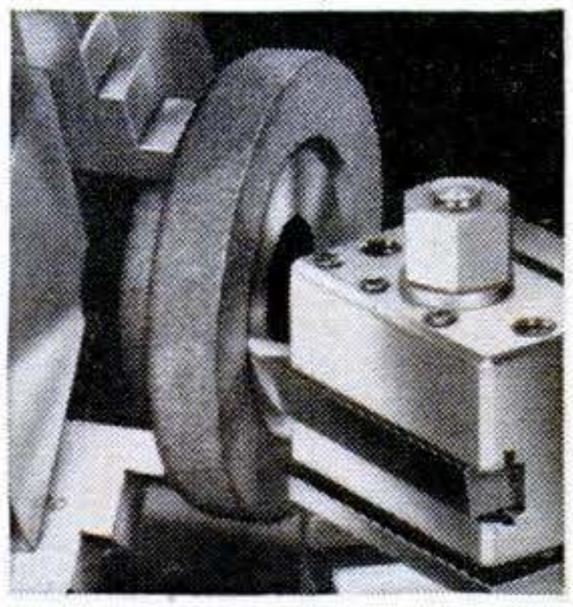
TURNING



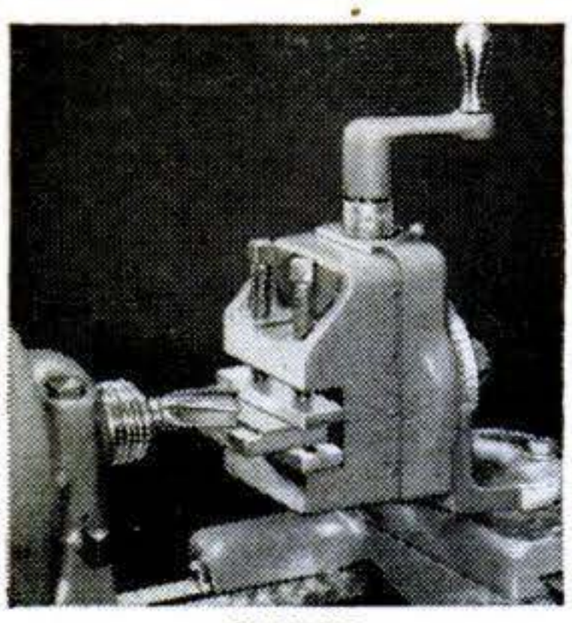
BORING



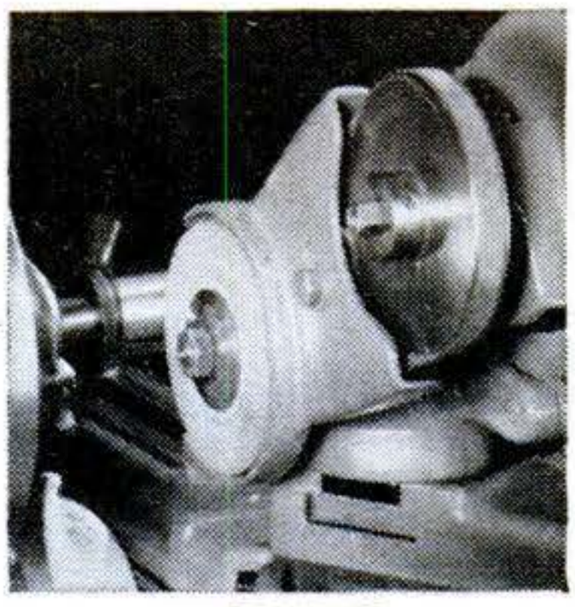
THREADING



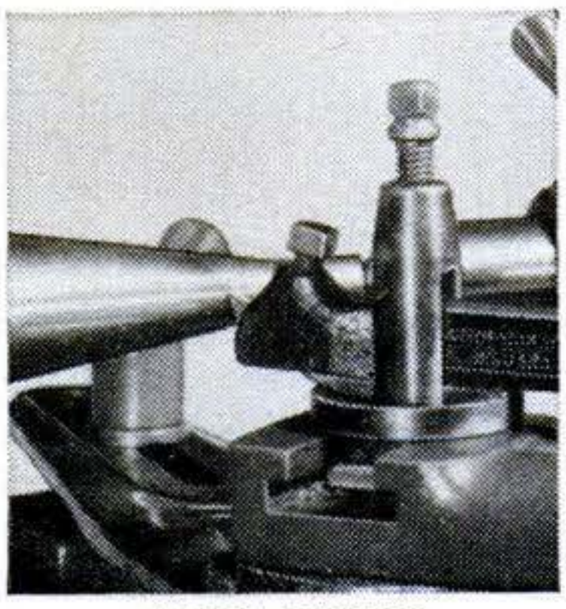
FACING



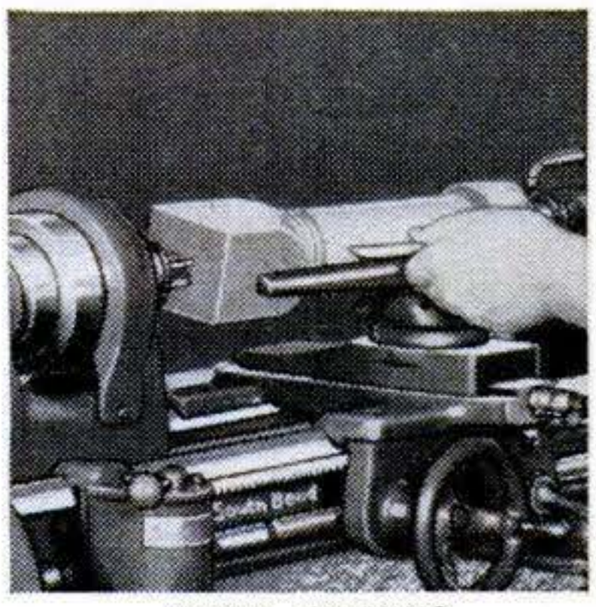
MILLING



GRINDING



TAPER TURNING



WOOD TURNING

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Are You Giving Your Wife The Companionship She Seeks?

YOU may be giving your family all the love and care you are able to. You may have given your wife a good home, security, many of the conveniences all women yearn for . . . but are you giving her the full companionship which she expected out of marriage? Are you sharing common interests with her? Or are you always "too tired" to see friends, to go out for an occasional evening of fun and relaxation? Are you really giving your family and wife the time and energy which they expect?

Or do you come home from work with only the "left-overs" of your vitality for your family? Is time catching up with you too fast . . . at work, at play?

If so, your condition may simply be due to a common vitamin and mineral deficiency in your diet. Yes, you may be well-fed, but poorly nourished. The food you eat may just not contain the necessary amounts of vitamins and minerals to keep you healthy and vigorous. You owe it to yourself to find out whether a food supplement such as VITASAFE capsules can restore the youthful feeling you'd like to have. And you can find out at absolutely no cost by taking advantage of this sensational free offer!

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Safe High-Potency Nutritional Formula

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To prove to you the remarkable advantages of the Vitasafe Plan . . . we will send you, without charge, a 30-day free supply of high-potency VITASAFE C. F. CAPSULES so you can discover for yourself how much healthier, happier and peppier you may feel after a few days' trial. Just one of these capsules each day supplies your body with over *twice* the minimum adult daily requirement of Vitamins A, C and D—*five times* the minimum adult daily requirement of Vitamin B-1 and the *full* concentration recommended by the National Research Council for the other four important vitamins! Each capsule contains the amazing Vitamin B-12, one of the most remarkably potent nutrients science has yet discovered—a vitamin that actually helps strengthen your blood and nourish your body organs.

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Vitamin A	12,500 USP Units	Calcium Pantothenate	4 mg.	Molybdenum	0.1 mg.
Vitamin D	1,000 USP Units	Vitamin E	2 I.U.	Iodine	0.075 mg.
Vitamin C	75 mg.	Folic Acid	0.5 mg.	Potassium	2 mg.
Vitamin B_1	5 mg.	Calcium	75 mg.	Zinc	0.5 mg.
Vitamin B_2	2.5 mg.	Phosphorus	58 mg.	Magnesium	3 mg.
Vitamin B_6	0.5 mg.	Iron	30 mg.	Choline Bitartrate	31.4 mg.
Vitamin B_{12}	1 mcg.	Cobalt	0.04 mg.	Inositol	15 mg.
Niacin Amide	40 mg.	Copper	0.45 mg.	dl-Methionine	10 mg.
		Manganese	0.5 mg.		

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